TOPICS OF THE MONTH

Belgian acetylene process

THE Soviet agency Techmashimport recently signed an agreement with the Belgian company Etudes et Recherches Industrielles (E.R.I.) to supply a plant producing acetylene from natural gas in the U.S.S.R. The production process belongs to the Société Belge de l'Azote et des Produits Chimiques du Marly (S.B.A.) which will be responsible for the engineering design and the supply of the equipment for this plant.

For many years S.B.A. has been interested in producing acetylene by a different method than the one involving calcium carbide, making use of some of the readily available gaseous and liquid hydrocarbons as raw materials. The process which was eventually developed is based on pyrolysis of hydrocarbons: using either (1) a gas rich in methane, such as natural gas, residual gas from refineries or ammonia plants, coke-oven gas, etc., or (2) hydrocarbons higher than methane such as propane, butane, pentane, etc. The latter route has the advantage of simultaneously producing high yields of acetylene and ethylene.

The cracked gases can be readily extracted and purified using cheap available solvents. Two complimentary solvents used by S.B.A. are: kerosene, which purifies the gaseous mixture from all hydrocarbons higher than C_2, and ammonia, which separates acetylene from the prepurified gaseous mixture giving a high selective yield with regard to ethylene.

By using these two solvents the acetylene can be obtained at a purity of up to 99.9%. Moreover, due to the inhibiting effect of ammonia on acetylene, the explosive hazards are minimised.

The process, therefore, allows more freedom in selection of raw materials. This will, in the long run, enable manufacturers to erect their acetylene plants on sites which need not necessarily be close to methane production plants. Obviously these advantageous factors motivated the Russians to purchase this rather than the more conventional process used in other countries.

Polypropylene

IS polypropylene the answer to every plant designer's prayer for the ideal material? Although only manufactured on a small scale in this country at present, reports of its chemical and thermal resistance are most favourable.

Its density, 0.90 to 0.91, is less than that of both high-density polythene, 0.94, and low-density polythene, 0.92. This makes it the lightest of all currently used thermoplastics. Despite this fact it has remarkable stiffness, surface hardness and abrasion resistance, in which respects it is superior to either high- or low-density polythene.

The very high crystalline melting point of polypropylene, 164 to 170°F., gives a material that may be extruded, blown and vacuum formed by conventional means used with polythene, although at higher processing temperatures. Its resistance to strong acids and alkalis is superior to polythene (for example, 40% caustic soda at 100°C. does not affect it). Although polypropylene dissolves in aromatic and chlorinated hydrocarbons at elevated temperatures, these solvents only exert a swelling action on the plastic at atmospheric temperature.

It is not surprising, therefore, that a wide range of applications for polypropylene have been suggested. One example for which it may be used is in ducting for fume extraction. We feel that particular attention must be paid by the potential user of this new plastic to environmental stress cracking and thermal degradation, to which polypropylene, like other members of the polyolefine family, is prone. These undesirable ageing features have, however, been overcome to some degree by suitably compounding with carbon black and antioxidants.

Research reactor for Britain

IT was recently announced by Vickers-Armstrongs that a licence agreement has been signed under which the company will manufacture and sell in the U.K. *Triga* atomic reactors which were developed by the general atomics division of General Dynamics Corporation.

The *Triga* reactor was designed to meet the need of academic and research institutions for a reactor of sufficient power and neutron flux to carry out research work and to serve as a training tool for students. It includes a high-capacity rotary specimen rack, a pneumatic transfer system for radioisotopes production and a central thimble for irradiations, physical measurements and the production of a neutron beam. Samples can be immersed in the water column at any unobstructed location and the relatively fast and thermal neutron fluxes around the core and reflector permit bulk irradiations. One of the more interesting features of the *Triga* is the inherent safety due to the fuel moderator elements, which consist of an alloy of uranium-zirconium hydride clad with 0.03-in.-thickness aluminium. This mixture of fuel and moderator provides a negative temperature coefficient acting as an automatic self-regulating mechanism, thus preventing the core from overheating or damaging itself in the event of a power excursion.

Triga's flashing capability provides extremely high power levels for short periods. According to Dr. de Hoffman, senior vice-president of General Dynamics, the prototype *Triga* has reached a peak power level of 1.5 million kw. in less than $\frac{1}{10}$ sec. The energy

released went directly to raising the temperature of the fuel materials so that the shielding water remained in the reactor without boiling or being expelled from the core.

The cost of this reactor has been estimated at less than £100,000. This relatively low cost combined with the simplicity in operation and ease of maintenance should bring this tool well within the scope of research workers in this country.

Engineering costs of new plant

WHILE a great deal has been written or spoken on the subject of capital cost estimating, very little mention has been made of the cost of engineering —one of the largest elements of cost of the facility. The factors that have a significant effect on the cost of engineering are many.

The state of knowledge of the process can vary from zero to 99%. An excellent example of the latter is the contact sulphuric acid plant. So well known are all the data that some engineering companies can literally take most of the drawings from the shelf, except those which are determined by site conditions. In such a case the actual cost to the engineering company is very low. The engineering price for the purchaser is a reflection of the knowledge, profit and royalties and bears little relationship to the actual cost. At the opposite end of the scale the original units built for the concentration of uranium-235 represented plants that were built upon a minimum of data. Three different processes were designed, engineered and constructed simultaneously to ensure that at least one of the plants would operate successfully.

Naturally enough the more complex a process or facility then the higher the cost to the engineer. If the programme is not well defined or planned this will result in maintaining an idle engineering staff.

Another factor which has a significant effect on the relative cost of engineering has to do with the materials of construction used in a plant. Although the engineering is almost the same in all cases the cost can be considerably reduced by intelligent selection of these materials.

E. R. Sweet, of Singmaster and Breyer, New York, points out (*Ind. Eng. Chem.*, 1959, **51**, 989) that another cost factor is the multitude of problems involved in expanding or redesigning a plant in an existing facility. This is in direct contrast to the 'grass roots' facility. Here there are few inhibitions placed upon the engineering, but this is scarcely the situation in the former case, where the cost of engineering may be increased by as much as 25%.

The evaluation of these tangible factors is not quite mechanical, but an experienced engineer with good judgment can be quite accurate in assigning quantitative effects to each of them.

Also to be taken into account are the scope of the work, the freedom of the engineer to control and schedule this work, the actual schedule itself and any arbitrary restrictions which necessitate redoing engineering.

Radioisotopes

WE should like to draw the attention of our readers to the special feature in this issue on radioisotopes. Although they have only been freely available during the last few years, they have already appreciably contributed to research. Many of these can readily be prepared by irradiating 'targets' of ordinary chemical elements with neutrons in a reactor. The isotope production unit at the Atomic Energy Research Establishment, Harwell, offers an irradiation service based on reactors *Bepo* and *Dido*, and can provide for thermal neutron fluxes of up to 10^{14} neutrons/sq.cm./sec.

Irradiation of targets of the corresponding naturally-occurring elements in these reactors can produce such radioisotopes as sodium-24, potassium-42, arsenic-76, bromine-82, cobalt-60 and zinc-65. In some cases the resulting product can be used directly. It is often found, however, that the simple irradiation of a substance in a reactor will not provide the radioisotope in the precise form of purity needed by the user. In these cases a radiochemical separation of the active substance from its parent material is required. Examples of this are iodine-131, phosphorus-32, sulphur-35 and chromium-51.

Stocks of radioisotopes are held at the Radiochemical Centre, Amersham, provided their half-life is sufficiently long. In the case of sodium-24, potassium-42, gold-198, iodine-131 and phosphorus-32, where the half-life is too short, a regular weekly production schedule is maintained, thus enabling users to obtain a service at short notice.

Due to growing interest in the rarer radioisotopes, like cobalt-58 and manganese-54, multistage nuclear reactions have been exploited, giving low yields of these materials.

An interesting development is the work which the Radiochemical Centre is carrying out in conjunction with the University of Birmingham on a range of isotopes produced in cyclotrons. Some of these include iodine-124, sodium-22, bismuth-206 and arsenic-74.

British scientific attache in Moscow

DR. D. A. SENIOR left London last month to take up his new post as Scientific Attaché to the British Ambassador in Moscow. One of his last official engagements in London was to see Lord Hailsham, Minister of Science.

Dr. Senior has no specific technical assignment in Moscow, but will cover the broad field of science and technology, including the physical sciences, biology, medicine and agriculture. His aim is to promote good relations and understanding between the two countries in these fields and to facilitate exchange of information. It is to be hoped that this appointment will pave the way towards a new interchange of academic ideas at the highest levels between this country and many other technologically developed countries throughout the world. This will follow the trend set by both the United States and Soviet Russia of attaching scientific personnel to important foreign embassies.

The Orgel project

THE Scientific and Technical Committee of Euratom met in Brussels recently. The countries comprising Euratom (those of the European Common Market) have no enriched uranium at their disposal and are therefore primarily interested in natural uranium-heavy water type reactors. For this reason particular attention should be paid to the Orgel project, discussed by the committee. This involves the study of a heavy water moderated reactor with organic liquid cooling. As part of this project, France is preparing to construct a heavy water pile, EL 4. In addition to this, the German firm Siemens is intending to develop a pressurised heavy water cooled and moderated reactor. Canada, also, which recently concluded an agreement with Euratom, is about to finish the construction of another heavy water reactor at Chalk River. It is of interest to note that, due to a collaboration agreement with the U.K., the vast experience of British scientists and technologists in the reactor field will be placed at the disposal of Euratom.

Largest plate heat exchanger

ENGINEERS of A.B. Separator, the Swedish company which heads the international Alfa Laval-De Laval group, have designed, produced and installed 12 of the largest plate heat exchangers in the world. Made of stainless steel, the 12 plate heat exchangers, each weighing 5 tons, were installed in the Ostrand mill of Svenska Cellulosa Aktiebolaget at Timra in Sweden.

Svenska Cellulosa placed the order for De Laval plate heat exchangers after extensive tests over three years. These plate heat exchangers were designed to deal with a high liquid throughput of 500,000 l./hr., cooling the outgoing sulphite liquors from 50 to 6°C. while heating the same quantity of fresh water from 0 to 44°C. This represents a 90% recovery of heat and involves a saving of 15,000 Swedish kronor (about £1,000)/24 hr. continuous operation.

The design features include a special type of corrugation of the heating surfaces to minimise deposition of fibres and particles contained in the waste water. Cleaning of this heat exchanger is facilitated by hydraulic devices and special hydraulic compressors speed up assembly of individual plates. Additional plates can be supplied for the heat exchanger so that they can be expanded according to the amount of liquid which has to be handled. The whole mechanism is constructed to withstand a pressure of up to 140 p.s.i., with a pipe diam. of 18 cm., allowing a throughput of 14,000 l./min. without loss of pressure.

The overall advantage of this new design over the old 'tube and shell' method is the flexibility in use and ease of maintenance.

This interesting venture may eventually provide an economic solution for industries where operations involve the handling of liquids in large quantities such as the cellulose pulp and paper industries.

French chemical industry

THE French chemical industry which in 1952 was the fourth largest industry in France managed to rise to third place last year. This is largely due to new export markets which France has attained in many parts of the world. Increase in value of chemical exports in 1959 over the previous two years was more than 40%.

The break-down of chemicals exported by France last year is shown as follows:

	Million francs
Organic chemicals	16,934
Essential oils and perfumes ..	12,578
Inorganic chemicals	8,309
Pharmaceuticals	4,510
Plastics	5,628
Various	2,697

Undoubtedly the large production of organic chemicals and plastics is due to the increasingly growing capacity of the petrochemical industry. This is also beginning to provide alternative raw materials for the manufacture of some basic chemicals. Calcium carbide, for example, long used in the synthesis of acetylene, is being replaced by the more readily available methane, from which acetylene is obtained by cracking.

It will be of special interest to watch developments in the essential oil industry. This is probably the oldest branch of the French chemical (or possibly alchemical) industry, situated mainly in the flower-growing districts of Provence. In order to stabilise prices and improve uniformity of these essential oils, the U.S.A. has since the war developed processes by which these are synthesised from petrochemicals. The tendency of other countries in Western Europe, notably the U.K., has been slowly to follow suit. France, by virtue of her highly developed petrochemical industry, should well be able to do the same. But might this not upset the flower growers of Provence, with possible long-term effects on *haute-couture?*

Staff College

'I THINK that co-operation between industrial and commercial firms on the one hand, and the public system of education on the other is essential for the teaching of advanced technology.' This is an extract from a letter sent by Sir Alexander Fleck to about 250 industrial firms. Sir Alexander, with the support of Sir David Eccles, Minister of Education, appealed to industry to help in the establishment of a staff college for senior teachers in colleges of technology and senior industrial staff.

The proposal to establish such a college was included in the recommendations of the report of the Willis Jackson Committee on the supply and training of teachers for technical colleges. The committee considered that there was a need at the top level of the technical teaching profession for men with the breadth of outlook and attitude of mind to exert a strong influence both within their own colleges and upon

the industrial and commercial firms which they serve. Existing facilities for teacher training or for refresher courses could not be expected to provide the kind of experience which a senior teacher requires to fit himself for posts of high responsibility.

Sir Alexander is asking industrial and commercial firms to contribute £100,000 as a single contribution, of which £60,000 has already been promised after private approaches to 30 firms. The running costs, amounting to £30,000 p.a., will be paid mainly from public funds. The college is intended to be quite small, offering a course lasting from two to four weeks throughout the year, which would probably start before the end of 1961. To allow each participant to make his individual contribution to the course, the total number of participants will not exceed 30.

Each course will be devoted to some different major topic of interest to technical colleges, as, for example, the development of teaching methods, the organisation of new courses, the emergence of new technologies, and the administration and organisation of colleges. The courses would not be run on a system of lectures but would be much freer and more in the nature of a pooling of ideas and experience.

It is pleasing to note that both industry and institutions of higher learning are beginning to understand that neither can exist without the other. On the one hand it is short-sighted for industry to employ a graduate if he is given little opportunity to maintain his university contacts and outlook and, on the other, it is self-defeating on the part of universities to carry out industrially sponsored research work only within their laboratory ivory towers. Extensive interchange at all levels is the only way to break down the considerable suspicion with which industrialists and academic teachers still eye one another.

Modern dyes

MR. CLIFFORD PAINE of I.C.I., when delivering the Sir William Jackson Pope Memorial Lecture at the beginning of February, mentioned some of the principal requirements which have guided modern research in dyes. They are:

(1) To retain easy methods of application, preferably the use of simple aqueous solutions.

(2) To achieve the standards of fastness, particularly light fastness, of the better vat dyes, but preferably with simpler methods of application.

(3) To achieve high standards of wet fastness, by attaining irreversability of the dyeing mechanism, either through exceptional dye to fibre affinity, or by forming a water-insoluble colouring matter within the fibre.

(4) To design dyestuff structures with a high intrinsic affinity for specific fibres—initially for the natural fibres and cellulose acetate rayon, but later for the man-made synthetic fibres.

Mr. Paine recalled the deep concern that was felt by British scientists during the first world war at the extent to which organic and dye chemistry in this country had fallen behind that of the Germans. The cause of those British deficiencies was simply that we had not devoted enough money or effort to industrial organic chemical research. The situation has been radically altered since the first world war, though there is not yet any room for complacency. Nevertheless, it is a source of satisfaction to note that of five or six major discoveries made in the field of dyestuff technology since the first world war, some four of these can be credited to British chemists.

Mr. Paine's reflections on dyestuff chemistry we feel can justly be applied to other branches of the chemical industry which are now beginning to reap the fruit of many years of research and development.

Rhenium in commercial production

WROUGHT rhenium in wire, rod and strip form is being produced commercially for the first time in the U.S.A. by Chase Brass & Copper Co., a subsidiary of Kennecott Corp. Consumption of the metal has increased by over 400% in the past few years and, although a rare metal, sufficient quantities are available to warrant its consideration for commercial applications, potential production capacity of the U.S. alone being estimated around 20,000 lb. p.a.

According to Dr. D. K. Crampton, director of Chase's research and development, two aspects have spotlighted this metal. One is the broadening technology and production of high-temperature metals and the other the quest for increased reliability of electrical and electronic components.

Pure rhenium powder is produced by Chase as a by-product from the roasting of molybdenum sulphide from the Kennecott Copper Corp. and pressed into bars at 25 to 30 tons/sq.in. These bars, with a theoretical density of about 45%, are then presintered at 1,200°C. Final density of the sintered bar ranges 90 to 96% of theoretical density. From pressed bar to sintered bar a linear shrinkage of approximately 15 to 20% occurs in each direction.

All fabrication of rhenium metal is done by cold working, which is extremely difficult because of the rapid rate of work hardening of the metal. Rolling, swaging and drawing require frequent anneals between reductions and hydrogen is normally used as a protective atmosphere.

An extremely dense silver-coloured metal, with a melting point of 5,756°F., surpassed only by tungsten and carbon, rhenium finds its most important present applications in high-temperature measurement and control. Thermocouples of rhenium and tungsten make possible measurement and control of temperature up to 4,500°F.

While not a structural metal, it holds great promise as a possible welding material for molybdenum, either in its pure state or alloyed with molybdenum. Recently the first casting of molybdenum was produced in the U.S. by the Bureau of Mines, and the search for feasible techniques of handling and working molybdenum are being intensified. Alloys of these two metals have better mechanical properties than molybdenum, at lower cost than pure rhenium.

Radioisotope Uses in Chemical Engineering

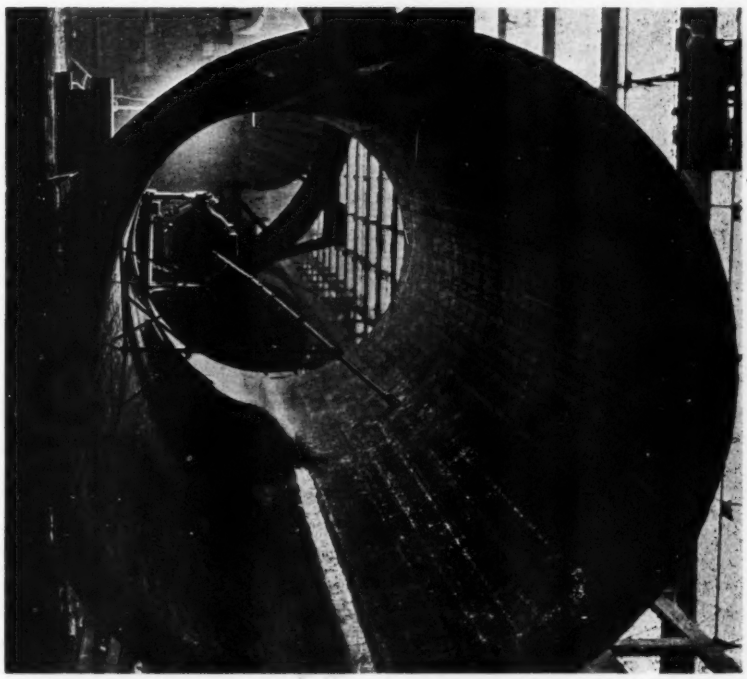
By C. E. Mellish,* D.Phil.

The engineering applications of radioisotopes can be divided into three categories based on their properties. This article describes some of these applications in tracers, thickness measurement, radiography and ionisation.

THE industrial use of radioisotopes dates back for many years, before these isotopes became freely available from nuclear reactors. In those days, the production of radioisotopes was carried out in particle accelerators, mainly cyclotrons, and for many applications the quantity available was small and the price high. Since the recent rapid growth of the atomic energy industry, the use of radioisotopes has expanded at a very high rate, so that estimates of financial saving through such use have been of the order of $40 million p.a. in the U.S.A. and £4 million p.a. in the U.K.

The value of these radioisotopes lies in the radiation that they emit, characterised as long ago as 1899 as α-, β- and γ-radiation. α-radiation consists of doubly charged helium nuclei, of which even the most energetic have a range of only a few centimetres of air, and are easily stopped by a sheet of paper. β-radiation consists of high-speed electrons of energy that depends on the particular radioisotope considered; 'weak' β-particles may be stopped by thin aluminium foil, but 'strong' β-particles will need aluminium sheets up to ¼ in. thick to stop them completely. γ-radiation is not particulate, but consists of electromagnetic rays of the same kind as *x*-rays from an *x*-ray tube. While *x*-rays from such a tube do not normally have energies greater than about 250 KEV, it is quite usual for γ-rays to have energies of, say, 2 MEV (2,000 KEV). This means that γ-rays can be more penetrating than the most penetrating *x*-ray; some can pass through 10 in. of steel.

A particular radioisotope may emit only one of these kinds of radiation, or any combination of two, or all three kinds. The irradiation of most elements in a nuclear reactor, however, produces radioisotopes that emit either β- and γ-radiation, or β-radiation only, and these are undoubtedly the ones of major importance. The choice of an isotope for a particular application depends not only upon the radiation that it emits, but also upon its rate of decay. The intensity of the radiation from a radioactive source decays exponentially with time; the rate of decay is measured by the 'half-life' which is the time taken for the intensity of the radiation to fall to half its original value. Thus, material with a short half-life is decaying quickly, and that with a long half-life is decaying slowly.



Radiography of a pipe joint with a γ-ray source contained in the axial tube.

The major applications of radioisotopes in engineering industry fall into three categories based on their properties, as follows. First, any radioisotope constantly signals its physical position by the radiation it emits. On this fact is based their use in pipelines and fluid handling, in mixing processes, and tracer studies generally. Secondly, the radiation from radioactive sources is absorbed and scattered by matter, the extent depending upon the composition and thickness of the absorbing or scattering material. This gives rise to applications in thickness measurement, radiography and level gauges. Thirdly, the radiation causes ionisation in matter and, with large sources, this can be used to alter the physical properties of materials.

Nearly every element has a usable radioisotope, and many have several; often a choice can be made when a radioisotope of a particular element is required. For instance, three radio-

**Isotope Research Division, A.E.R.E., Harwell.*

isotopes of manganese can be produced, all γ-emitting, with half-lives of 2.56 hr., 6.0 days and 300 days, respectively. The use of short-lived isotopes can be expected to increase with the large number of teaching, research and power reactors now being built, which are capable of supplying local users with short-lived material that cannot be transported over large distances without prohibitive decay losses.

Tracer applications

Important among the applications that use the self-indicating properties of radioisotopes are those which concern the handling of fluids in pipelines, and one of the most useful and best established of these is the radioactive method of testing for leaks. In a new water main, for instance, a section containing a suspected leak is first pressurised with water containing a little radioactivity and, after about half an hour, this solution is run out and the pipe flushed out with clean water. At any place where the pipe leaks, radioactive solution will be passed out into the earth surrounding the pipe at one of the joints in the case of a new pipe. All that is necessary now is to make a hole with a crowbar near each joint in the pipe and lower a counter, connected to a counting ratemeter, down the hole to test the level of radioactivity there. The leaky joint is indicated by an increased count rate on the ratemeter, and confirmed by the presence of radioactive contamination in the soil. For this application, radioactive sodium is nearly always used, as it possesses very penetrating γ-rays, and its half-life is only 15 hr., so that the test solution can soon be disposed of safely.

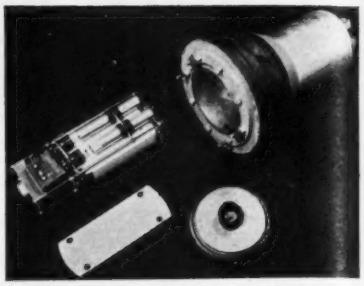
In the case of pipelines carrying petrol, oil, etc., use can be made of the ' go-devils ' used to clean out pipelines for an extremely elegant method of finding the leak after the test solution has been run out. These ' go-devils ' are brush systems that are forced along the pipes by hydraulic pressure, and one of these is made to tow a self-contained counter and miniature wire recorder. As this passes a position where the pipe has leaked, a burst of counts is recorded, which can later be played back from the wire recorder to give the position of the leak. Exact positioning of the leak, in the case that the movement of the go-devil is not completely uniform, is aided by placing standard sources at fixed distances along the pipe to give a reading of distance travelled on the recorder.

Radioactive markers can also be used as a method of locating these go-devils, when in the course of cleaning out obstructions they become stuck in the pipes themselves.

Leak testing with isotopes has been extended to such different fields as leaks in gas-filled electric cables, and in the separate amplifiers of submarine telephone cables.

Flow measurement with radioisotopes can be done in many different ways. At least ten different methods exist of using radioactivity to measure flow in gas, liquid and fluidised systems. In particular these methods are useful when the fluids involved are corrosive, toxic, under high pressure, or when remote indication is needed. Examples of the methods include the use of a rotating vane with a radioactive source mounted on it, to give a burst of counts with every revolution, a tapered float in a conventional flowmeter that interrupts a collimated beam of γ-rays, and the measurement of catalyst flows in a refinery ' cracker ' by means of marked catalyst beads.

Assembled ' go-devil.'



Dismantled ' go-devil ' showing counters and miniature recorder.

In this section, the property of radioisotopes being exploited is their capacity for self-advertisement, and under this heading must come tracer applications in general and mixing experiments in particular. The most important investigational work with radioactive tracers has undoubtedly been in oil refineries, where they have been used for investigating coke formation on catalyst, tracing tar entrainment and flow patterns, and checking the chemical balance of particular components.

Mixing problems usually arise from products that contain very small proportions of important ingredients, *e.g.* manganese sulphate in cattle food.

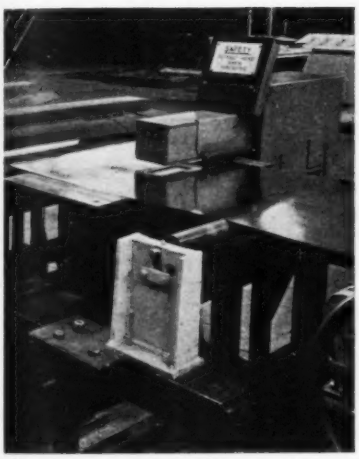
In cases such as this, it is very difficult indeed to be sure that the additive is really uniformly distributed in the product, but if the additive can be made radioactive without altering the properties of the mix in any way and the final product monitored for radioactivity, it is possible to check on the efficiency of mixing and in certain cases to save time in production by ensuring that mixing is not carried out for an unnecessarily long time. A short-lived radioisotope should be used for such experiments if possible, so that none of the product is wasted, but can be distributed in the usual way when the radioactivity has decayed. One or two such experiments are usually sufficient to check the efficiency of mixing of a particular process; they are not needed as a routine measure.

Thickness measurement

The measurement of thickness by the use of radioisotopes is dependent upon the way in which the radiations from radioactive sources are absorbed in matter. The absorption of such radiation can be measured continuously with a counter to give a

continuous measure of the thickness, say, of cardboard sheet, or the density of a liquid in a tube; alternatively the absorption can be measured by the effect of the radiation penetrating a specimen on a photographic film, *i.e.* by radiography. Thirdly, it is possible to use absorption of radiation by the liquid in a tank to measure the level of such a liquid, using a qualitative measurement of whether or not there is absorbing material, *i.e.* liquid, between the source and the counter.

The continuous thickness gauges mounted on production lines have undoubtedly been one of the major uses of radioisotopes. For thin materials, β-ray gauges are used, and the choice of the radioisotope used is based on the rule that a normal specimen should absorb about half the radiation from the source. Clearly, a specimen thinner than normal will give rise to too many counts at a detector mounted



Thickness gauge used in manufacture of thin steel sheet.

on the other side of the material to be measured, and a thick specimen will give too few counts. In many cases, the signal derived in this way of the departure of the product from normal thickness can be fed back to control the thickness of the material being produced, and keep it to the proper specification. Ordinary contacting methods are often inapplicable because the product measured is fragile, sticky or wet, and here the non-contacting, non-destructive radioisotope method comes into its own. This technique is widely used, for instance, in the sheet metal and paper industries.

In these applications the thickness of a material of fixed density is measured. If, on the other hand, a product is made to a fixed thickness, the same type of gauge will give a measure of its density, for the absorption of radiation actually measures mass per unit area, which is equal to density multiplied by thickness. The density of cigarettes, which are always the same thickness, may be measured in this way; bubble formation in a pipe can be detected, as this causes a change in bulk density measurable with a source and counter on opposite sides of the pipe.

When only one side of an object or sheet of material is available to the investigator, it may still be possible to measure its thickness by a backscatter gauge, which depends on the variation of the amount of β- and γ-rays reflected or scattered from an object, caused by variation of its thickness or of the material of which it is composed. β-backscatter gauges have been used for the measurement of lacquer or paint on steel plate; the steel reflects far better than the lacquer, so that increasing lacquer thickness reduces the count rate obtained, by absorption of the reflected β-particles. γ-backscatter gauges will measure flaws in the walls of steel pipes and, by using the change in energy of γ-rays on scattering, the need for heavy shielding between the source and detector can be eliminated.

The simple principle of the radioisotope level indicator has already been mentioned; a source and counter on the opposite sides of a tank of liquid are moved up or down the sides together until absorption stops or starts, and the counter rate suddenly rises or falls. This point marks the level of the liquid; it is possible to use a servo motor to move the source and counter so that they both provide continuous record of the level of the liquid.

The radioactive sources used for thickness gauges are always hermetically sealed, so that there is no danger of radioactive contamination of the material measured. In addition, the sources are usually positioned in holders so that their radiation is always shielded except when the holder is in position in the gauge.

Radiography

Radiography by β and γ sources is not to be thought of as a technique that replaces conventional radiography with *x*-ray machines, but as a supplement to it that has considerable advantages in particular cases. Radiography, as mentioned above, is a kind of thickness measurement, but here the matter for concern is usually variations in thickness over small areas of particular objects, instead of in the overall thickness of the objects themselves. The question of spatial resolution is therefore vital to the success of an experiment in this field, and for a short exposure and good resolution, a source of high intensity and small cross-sectional area is needed. These are conditions that are satisfied much more easily with an *x*-ray tube than with a β or γ source, and it is fair to say that, for small objects composed of the lighter elements, *x*-rays from an *x*-ray tube are more suitable. An *x*-ray tube has an additional advantage, too, in that there is no radiation or contamination hazard attached to it when it is switched off.

On the other hand, when radiographs are needed of heavy and dense objects, the energy of the radiation required is much higher than can be reached with a normal *x*-ray tube—for examining large steel castings, for instance, a γ source like cobalt-60, with γ-rays of energy around 1,000 KEV, is needed. Because of the necessity of keeping the source size small, for good spatial resolution, the exposures used are much longer than those required with an *x*-ray tube; the equipment is much cheaper and simpler than *x*-ray equipment, however, and needing no power supplies or water cooling is fairly portable. It can easily be used in the field for testing, for example, pipe welds, with a source inside the pipe and a light-tight envelope of film wrapped round the joint.

Mention should be made here of the technique of autoradiography, in which the position of radioactive constituents of some non-homogeneous material is found by placing a photo-

Checking the level of liquid in carbon dioxide cylinders.

graphic film in contact with the specimen, and noting the parts of the film blackened by the radiation emitted. The distribution and diffusion of components of metal alloys are particularly well studied by this technique.

Ionisation by radioactivity

In the past few years, a considerable amount of work has been done on the possible uses of the ionising radiation from the large sources now becoming available, particularly as fission product from nuclear reactors. Apart from the biological applications, in sterilisation, etc., there are considerable possibilities for using this radiation in chemical processes, either to produce new materials or to improve present production processes. The effect of radiation on the manufacture of polythene illustrates these two general points: in the presence of large amounts of radiation it is possible to polymerise ethylene to polythene at lower temperatures and pressures than those usually employed and, given favourable economic factors in relation to source costs, etc., this could be of considerable value. Exposing the finished product to radiation produces polythene with an increasing amount of cross-linking between the long molecular chains that compose the substance, so that a mass of polythene can be effectively converted through the linking of these chains into one large molecule. This change alters the physical properties of the polythene in ways that may be valuable for particular applications; it becomes more resistant to heat, and to corrosive fluids, for instance. Rubber can be vulcanised by radiation without chemical additives, and the quality of the product is better than that obtained by conventional means. At the present time, however, the use of radiation for this type of work has not been applied to any extent to industrial processes, and this is likely to remain the situation until cheaper radiation sources become readily available.

Conclusion

In an article of this size it is hardly possible to do more than mention the major fields in which application of radioisotopes have become well established. The future will undoubtedly see much further expansion both in these fields and in many uses which are at present little used or confined to the laboratory, as radioisotopes become accepted as normal tools of industrial investigation and control.

Ionising Radiation

Conference Report

THE uses of ionising radiation can be divided into two broad categories. It can be used as a tool of investigation, measurement and testing and it can be a direct agent in inducing chemical processes.

It has found a variety of uses in industry as a checking tool. For example, it has served in detecting leaks in water, gas and electricity mains, in measuring the thickness of metal level and density of fuel, and in checking the thoroughness of mixing. Most of such applications are carried out with small radioactive sources either used externally or introduced into a substance as a tracer.

Chemical reactions

The initiation of chemical reactions usually requires larger and more powerful sources of radiation, such as can be provided by substances like cobalt-60 and caesium-137 or by machines which accelerate nuclear particles to very high energies. Cobalt-60 is a radioactive isotope of cobalt, produced by the irradiation of ordinary cobalt-59 with neutrons, while radioactive caesium or caesium-137 is found among the end products of nuclear fission in a reactor. Both emit highly penetrating gamma rays and both have fairly long half-lives, which means that their radioactivity lasts for considerable periods of time. The most useful particle - accelerating machines in this field are those which accelerate electrons to energies considerably higher than those possessed by electrons (beta particles) emitted by radioactive substances.

These high-energy radiations produce interesting reactions both in organic life and in materials for industry. Many of such reactions can, of course, be brought about by other means: for example, by chemicals or by heat and pressure. Radiation is a supplementary but more effective method.

Polymerisation and cross-linking

Some of the most important industrial uses of radiation are in the field of polymerisation, which is usually brought about by extremes of heat and pressure. But with the help of radiation, this process can be initiated at much lower temperatures and pressures than normally required, as for example the polymerisation of ethylene to polythene.

Another effect is cross-linking, or bridging of polymer chains. By this process, plastic material having a higher heat resistance can be obtained.

Several papers presented at the International Atomic Energy Agency conference in Warsaw on the application of large radiation sources in industry, particularly to chemical processes, were devoted to the application of ionising radiation to polymerisation and other reactions in the manufacture of plastics. Polymerisation mechanism of the olefine series of hydrocarbons was discussed and the technical characteristics were described. It was pointed out that the cross-linking effect of radiation resulted in an improved product, opening the way to new applications of polythene. Irradiated polythene film has been sold for many years, and electrical wire has been made with irradiated polythene as the insulating jacket. Other reactions discussed included the cross-linking of polyvinyl alcohol and PVC.

Other papers dealt with the chain oxidation and chlorination of hydrocarbons. The effects of radiation on coal and methanation reactions were also discussed. Another subject that came up related to the possibility of improving catalysts by irradiation. Some of the effects produced by ionising radiation are likely to influence catalytic properties and attempts have been made to alter the catalytic activity of solids by radiation.

Of interest to our readers . . .

A number of articles appearing in our associate journals this month will appeal to readers of CHEMICAL & PROCESS ENGINEERING.

The Manufacturing Chemist has an article on instrumentation and process control in the fine chemical industries and one on continuous analysis of process streams.

Paint Manufacture includes an article on the Ferranti-Shirley coneplate viscometer.

Petroleum. There is the second part of the drilling fluids review.

Food Manufacture has an article on brewing.

Automation Progress has articles on the industrial applications of *p*H control, attitudes to automation in Britain and the U.S.A., pneumatics in automation and control of space heating.

Technology and economics

Many of the papers presented at the conference examined problems connected with the design and construction of suitable radiation sources for the varied uses in industry. Cobalt sources of different types were described in detail and their operating experience was narrated and discussed. The relative efficiency and usefulness of different radiation sources was also considered. Apart from the more penetrating radiations such as the gamma rays from radio-cobalt or the artificially accelerated electrons from particle-accelerators, the potential uses of ordinary beta radiation from fission products were taken into account. Many industrial processes require surface radiation treatment rather than penetrating irradiation and, for these, fission product beta sources might be particularly useful.

Related to the problem of technological efficiency is the question of cost. The conference considered not only the relative economic advantages of various types of radiation facilities but also the larger question whether, and in what fields, radiation processing is economically more attractive than the convenient processing methods. Possibilities of reducing the costs of radiation processing in specific fields were examined.

Isotope shop

The first 'isotope shop' will be opened shortly on Moscow's Lenin Avenue. It will have a neon sign in Russian, French and English reading: 'Atoms for Peace.'

The shop will offer for sale the entire range of radioactive and stable isotopes produced by industry, and also protective materials, equipment and instruments. It will guarantee prompt delivery of short-lived isotopes.

A demonstration hall will feature the latest achievements in the application of isotopes, provide consultation and show popular science films. There will be exhibitions on the use of isotopes and penetrating radiations in industry, medicine and agriculture.

Fire protection. A booklet on industrial solvents and flammable liquids gives in table form the following information: physical constants, flash points, flammability limits, autoignition temperature, susceptibility to spontaneous heating and suitable extinguishing agents. The booklet (No. 24) is available from Fire Officers' Committee, Fire Protection Association.

Radioisotope in Moisture Control

The slow neutrons generated in the sand are picked up by the neutron counting tubes and calculated by the electronic device shown here. The drum containing the source can be seen at the lower left.

PLUTONIUM-239 is being used to measure the moisture content of moulding sand at General Motors' central foundry division plant in Danville, Illinois, U.S.A. It is believed to be the first industrial application of this kind. The new technique utilises fast neutrons emitted from pure plutonium mixed with beryllium powder and sealed in a stainless-steel capsule. Plutonium atoms disintegrate, emitting alpha particles which interact with beryllium to form the fast neutrons. These fast neutrons collide with hydrogen nuclei in water mols. in the sand, producing slow neutrons that can be counted electronically. The number of slow neutrons produced is directly proportional to the sand's moisture content.

Before the nuclear device was installed at the foundry, moisture control depended on an experienced operator's hand-test or 'feel' of the sand; the amount of added water in the milling process depended on judgment. Sand samples from the hopper were spot-checked on laboratory equipment.

The new gauging is almost entirely automatic, a neutron-source pellet of plutonium-beryllium powder being lowered, through a stainless-steel tube, into the centre of each 30-cwt. batch of moulding sand in the hopper. The slower neutrons, which result from collisions with the hydrogen nuclei, are electronically counted by two neutron detectors in the tube carrying the neutron source. From this count, which is completed in about 45 sec., there is rapidly calculated: (1) percentage of existing water in the batch and (2) the exact amount of water to be added to maintain a predetermined level. The moisture content is indicated on a large dial which also shows the quantity of water needed. The mill operator pushes a button to drop the sand from the hopper to mill, and with a second button measures the desired amount of water into the miller.

Meanwhile, the nuclear device resets itself, to begin counting slow neutrons in the next batch of sand. This checking of every batch reduces human error and ensures close limits of moisture content all the time. It is not a sampling method. The accuracy of this sand moisture gauge is reported to be better than $\pm 0.05\%$ by weight over a range of 2.5 to 5.0% total moisture content.

Rigid safety precautions are taken by the company's industrial hygiene section. Operating personnel are protected by regularly checked film badges, thus keeping any radiation hazard well within safe limits. When not in use, the source is kept in a wax neutron-absorbing shield. Similar shielding surrounds the hopper, providing full protection when the source is in the sand. The sand is not contaminated during the moisture check, and is safe for handling after it has been carried out.

Industrial Radiography

By J. A. Reynolds*

THE need for perfection in the components of such devices as nuclear reactors and space vehicles has done much to stimulate the use of radiography for non-destructive testing and call attention to the growing use of gamma and *x*-radiation throughout industry.

The use of isotopes for radiography has increased so rapidly that sales have reached the ' cross-over ' point. That is, the isotopes themselves almost equal in value the isotope units being used.

The major advantages of radiographic testing are that the material being tested is not affected in any way—*i.e.* it is tested ' non-destructively '—and, in most cases, inspection is accomplished in much less time than is required by older inspection methods.

All phases

Being able to inspect the internal state of almost any material without affecting the material makes it possible, of course, to make tests on industrial products in almost every phase of fabrication, as well as in its finished form. It is cheaper, for example, to discover porosities, slag inclusions or other flaws in a raw casting than after money and time has been expended on set-up and machining. Many foundries, in fact, charge a premium for radiographically inspected castings and actually make more money on the radiography than on the castings themselves.

As successive stages of fabrication are completed, radiography is often the only way to make sure the job has been done properly. For example, radiographers follow on the heels of welders in the manufacture of aircraft, pipelines, bridges, boilers and ships.

Inspection of the final product is a necessity where it must be known whether concealed assemblies are properly positioned or as final proof that no flaws remain to cause trouble when the product is in use. Radiography also has a role in inspection and maintenance of many products and structures after they have been put into use. For example, radiographic inspection of many aircraft components such as landing gear, wing spars, fuselages and propellers are vital to safety. Engine maintenance relies extensively on radiography.

Radiation sources

With objects being radiographed ranging all the way from golf balls to 1-ft.-thick steel, a wide range of *x*-ray units and isotopes are needed. No single unit or isotope is suitable for all jobs.

The selection of the proper radiographic equipment and technique is affected by the following factors:

(*a*) Density of material, which may range from aluminium to uranium.

(*b*) Thickness of material, which can range from aeroplane skin to 12 in. of steel.

(*c*) The time available to do the job. Must the job be done on the production line or could an overnight exposure be made?

(*d*) Accessibility. Can the object be brought to the machine or must the machine go to the object?

(*e*) Conformation. A flat plate is easier to examine than a complex casting.

Radioisotopes have certain advantages over *x*-ray machines. In general, they are considerably cheaper than *x*-ray equipment of comparable energy. The average gamma-ray source (isotope) is small (pill sized) and can be used in small or cramped areas. Radiation is emitted in all directions, so it is easy, for example, to radiograph an entire circular weld at one time. Also isotopes need no electrical supply.

X-ray machines have the advantage of being adjustable as to the energy of their penetrating rays, so they can be regulated, within limits, to suit the thickness of material being examined. Also, an *x*-ray machine, having no radioactivity itself, can be turned off and needs no shielded storage space.

Table 1 shows *x*-ray energies appropriate to some typical materials:

Table 1

	Aluminium	*Steel*	*Bronze*
kv.	*in.*	*in.*	*in.*
50	⅛ to 1	—	—
140	1 to 3	¾ to 2	½ to 1
200	3 to 5	1 to 3	¾ to 1¼
260	—	2 to 3½	1 to 2
300	—	2 to 5	2 to 4
1,000	—	3 to 6	3 to 5
2,000	—	4 to 8	—
24,000	—	6 to 20	—

Gamma rays given off by radioisotopes are physically and radiographically equivalent to *x*-rays, so it is possible to rank various isotopes by comparing them with *x*-ray energies.

Table 2

Isotope	*Half-life*	*Equivalent energy*
Cobalt-60	5.3 yr.	2,000 kv.
Iridium-192	75 days	400 kv.
Caesium-137	30 yr.	600 kv.
Thulium-170	27 days	100 kv.
Samarium-153	47 hr.	75 kv.

These are approximate equivalent energies. Cobalt-60, for example, can be used for steel 1 to 12 in. thick and for heavy elements and alloys like lead, uranium, beryllium, copper and zircalloy, but not for aluminium, magnesium and other light materials. Iridium-192 can be used for steel down to ½ in. or less and up to about 3 in. thick and for relatively thick aluminium and magnesium.

Caesium-137 has an in-between status, which is one reason why it is not more widely used. It does nothing that cannot be done with cobalt or iridium and will reach the limits of neither.

Thulium-170 and samarium-153 are used mostly for special applications involving thin sheeting or tubing, but are not yet widely used for industrial radiography.

Half-life

In Table 2 the half-life of each isotope is listed. This means, for example, that cobalt-60 will lose half its strength every 5.3 yr. Radiographically, this means that exposure times become longer and longer.

When a user first puts his cobalt-60 machine into operation he knows that in 5.3 yr. his exposures will take twice as long. When they get too long to be practical or convenient, he replaces the source.

It is important to remember, however, that the quality of the radiation does not change, so the quality of his radiographs remains constant.

Iridium-192, which has a short half-life of 75 days, is usually replaced with a new source two to four times p.a. The best iridium-192 units are designed so that the source can be changed within 5 min. and the depleted source returned in the shipping container that brought the replacement.

Gamma or *x*-radiation?

It is impossible to say whether gamma radiation from isotopes or *x*-radiation is better unless the requirements of each particular case are studied.

**Picker X-ray Corporation*

Hydrogen Peroxide from Petrochemical Sources

By P. W. Sherwood

This article describes some recent manufacturing processes developed for hydrogen peroxide from petrochemical sources. Production of this chemical has increased by more than three-fold since 1948, and the new uses of hydrogen peroxide are discussed.

BETWEEN the years 1948 and 1958, hydrogen peroxide production in the United States rose from 15 to 54 million lb., a three-and-a-half-fold increase. Indications are that the upward trend will continue and probably accelerate in the years to come.

In keeping with the increase in demand, hydrogen peroxide plant capacity has been boosted from 23 million lb. p.a. at the start of 1951 to an estimated 95 million lb. p.a. in early 1959. This growth trend in hydrogen peroxide output is paralleled in other countries, notably in England and Germany.

Most of the new plant construction is based on petrochemical routes to hydrogen peroxide. There has occurred a definite shift away from the electrochemical and thermochemical inorganic methods of production which dominated the picture until 1953. Developments since then have taken two courses: manufacture of hydrogen peroxide by the oxidation-reduction cycle of alkyl anthraquinones, and manufacture of hydrogen peroxide by partial oxidation of lower aliphatic alcohols (probably isopropanol).

Pioneer plant in the alkyl anthraquinone process was Du Pont's production unit at Memphis, Tenn., which began operations in 1953. This was followed by plants of Solvay at Syracuse, N.Y., and by a 5-million-lb.-p.a. unit which Columbia-Southern took on-stream at Barberton, Ohio, in mid-1958. Yet another anthraquinone-based hydrogen peroxide unit was taken on-stream in early 1959 by England's Laporte Chemicals Ltd. at Warrington.

The largest single addition to hydrogen peroxide plant capacity has been Shell Chemical Co.'s unit at Norco, La., which was started up in late 1958 with a rated capacity of 30 million lb. p.a. This is the pioneer installation for the production of hydrogen peroxide by partial oxidation of aliphatic alcohols.

Markets for hydrogen peroxide

Market-wise, the important development of the last few years has been a definite shift in distribution pattern.

For one thing, there is growing interest in hydrogen peroxide for propulsion purposes. In this area, the chemical is used primarily as an oxidant in the bipropellant hot-rocket motor. It is, furthermore, a fuel in its own right in so-called ' cold ' rocket motors, such as the De Havilland *Sprite* assisted take-off motor.

Most of these propulsion applications are in the military field at the present time. These outlets are estimated at 15 to 20% of total hydrogen peroxide production. However, for the civilian market, too, hydrogen peroxide is finding new outlets. The resulting shift in distribution pattern is evident from Table 1:

Table 1. Distribution patterns for hydrogen peroxide (civilian market)

	1953 %	1958 %
Textiles	65	50
Chemical manufacturing ..	15	22
Pulp and paper	15	11
Other	5	17

The biggest consumer in the textile field is cotton bleaching. It is estimated that 80% of all cotton goods produced during 1958 were bleached by hydrogen peroxide. In the case of white wool and silk products, the use of hydrogen peroxide is imperative, as other bleaching agents attack and degrade the fibre. Pronounced advantage exists also in the use of hydrogen peroxide for bleaching most of the synthetic fibres.

Among civilian uses, probably the most promising future for hydrogen peroxide rests in chemical syntheses. Closest to realisation is Shell Chemical Co.'s new route to glycerine which involves the addition of hydrogen peroxide to allyl alcohol. The process is expected to consume the bulk of production of Shell's new 30-million-lb. hydrogen peroxide plant.

Another chemical use of potential importance is B.A.S.F.'s new process for the synthesis of ε-caprolactam from cyclohexylamine and hydrogen peroxide. The ε-caprolactam is, of course, used as raw material in the production of nylon-6 which has gained steadily in the American market since its introduction in 1954 (the European market has known this fibre for over ten years under the trade name *Perlon L*). At present, caprolactam is produced by methods of synthesis which do not involve hydrogen peroxide.

Among the more established chemical uses for hydrogen peroxide is the epoxidation of fats and oils (to yield, ultimately, plasticisers). This market is, however, threatened today by a recently introduced process in which peracetic acid serves in lieu of hydrogen peroxide as epoxidising agent.

Two outstanding chemical products which involve use of hydrogen peroxide in one of the synthesis stages are dieldrin and cortisone. Still other chemical applications for hydrogen peroxide include its use as polymerisation catalyst, as oxidising agent for certain products of high unit value (*e.g.* vat dyes) and as hydroxylating agent in the conversion of lecithin to a commercially important edible emulsifying agent.

Use of hydrogen peroxide for bleaching pulp and paper is increasing. In this case peroxide bleaching permits production of higher-grade paper from ground-wood pulp than would otherwise be possible. Hydrogen peroxide has also made inroads into the bleaching of soda and sulphite pulps, especially in the final production stages for speciality papers of extra brightness and colour permanence.

In the category of ' other products,' the largest hydrogen peroxide consumer is the cosmetics industry. Outlets in hair bleaching, dyeing and other cosmetic and pharmaceutical applications account for some 7% of the civilian market. This end use shows little growth, but has provided a steady sales outlet for many years.

More growth potential is seen in the use of hydrogen peroxide for foaming of rubber latex. Advantage

is here taken of the fact that one volume of liquid hydrogen peroxide may be decomposed to yield about 500 volumes of oxygen plus steam (generated by the heat of reaction). The reagent is incorporated into the latex batter, sometimes together with a decomposition catalyst such as ethylene diamine. The batter is then allowed to expand until it fills the mould, after which it is gelled and vulcanised.

Manufacturing technology

Prior to 1953, the manufacture of hydrogen peroxide in the United States was achieved in two ways.

(*a*) Treatment of barium peroxide with sulphuric acid. Barium peroxide is obtained by air oxidation of barium oxide at 750 to 800°C.

(*b*) Electrolytic methods involving intermediate production of salts of peroxydisulphuric acid. Most important of these is the electrolysis of NH_4HSO_4 to $(NH_4)_2S_2O_8$ followed by hydrolysis of the product to hydrogen peroxide and NH_4HSO_4.

Of these two methods, the latter is today clearly predominant. At the moment only one company (Westvaco at Carteret, N.J.) continues to produce hydrogen peroxide by the barium peroxide method. The economics of this process are aided by the existence of an adequate market for by-product barium salts.

The main expansion of new hydrogen peroxide capacity since 1953 has come from plants employing the alkyl anthraquinone route. This process involves the reduction of 2-alkyl anthraquinone followed by autoxidation of the resulting hydroanthraquinone. The carrier compound is derived from two petrochemicals: alkyl benzene (usually ethyl benzene) and phthalic anhydride.

The following main reactions are involved:

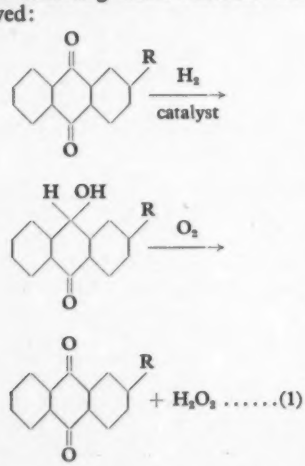


Fig. 1 illustrates a typical continuous flowsheet for the ethyl anthraquinone process. First step in the reduction stage is to dissolve the quinone in a solvent system to yield a solution of 10% strength. Various solvents have been proposed for this system; the difficulty is to find stable inert compounds which can solubilise ethyl anthraquinone as well as its hydrogenation product. Favourable attention has been given to such solvent systems as a 50-50 mixture of benzene and C_7 to C_{13} secondary alcohols and to a mixture of acetophenone and capryl alcohol (the latter mixture is said to be used in one of the newer commercial plants). Interest attaches also to the use of tributyl phosphate-benzene mixtures and to tricresyl phosphate.

The dissolved ethyl anthraquinone, regardless of solvent choice, is fed to the reduction chamber where it is joined by a finely divided hydrogenation catalyst and contacted with gaseous hydrogen as shown in equation (1). This conversion is normally carried out at 25 to 35°C. and at a hydrogen pressure of 15 p.s.i.g. Preferred catalyst is Raney nickel in a concentration of 5 to 10% by weight of quinone present. Conversion is about 90%.

The effluent from the reduction chamber is freed of suspended catalyst by centrifuging or filtration. The solids are returned to the hydrogenation stage. A side stream of this recycle catalyst is taken off for regeneration *en route* to the reduction (hydrogenation) chamber.

Quinhydrone solution leaving the centrifuge as filtrate is cooled to remove the heat of hydrogenation which it carries as sensible heat. The stream is then split. About 90% is taken directly to the oxidation tower where it is contacted with air to convert the quinhydrone to its quinone plus hydrogen peroxide as in equation (1).

No catalyst is employed in the oxidation tower. However, the use of air as such is possible only in conjunction with high-boiling solvents. At least one commercial installation has used benzene as one component of the solvent system. In this instance, there was so much danger of forming an explosive mixture with air that the gas stream fed to the oxidation tower had to be diluted with nitrogen.

The oxidation itself is carried out in an aluminium tower. Here, the oxidising gas is bubbled through the solution at 30 to 35°C. Complete conversion is achieved in this pass, yielding a product which contains 0.6 to 1.0% hydrogen peroxide. Care must be taken that the hydrogenation catalyst is quantitatively removed from the solution before it enters the oxidation tower since this catalyst also promotes the decomposition of hydrogen peroxide.

The effluent from the oxidation tower contains primarily hydrogen peroxide, ethyl anthraquinone and the solvents employed in the process. This stream is fed to an extraction column where it is contacted with water for hydrogen peroxide removal. The resulting aqueous hydrogen peroxide solution is at 10 to 20% strength. This is the crude product which must be upgraded to meet commercial requirements by means of purification and concentrating methods which will be discussed below.

The organic raffinate leaving the top of the extraction column still contains a small quantity of hydrogen peroxide which acts as catalyst poison in the hydrogenation stage. It is therefore necessary to destroy this residual hydrogen peroxide. Towards this end, the raffinate stream is treated with a nickel-silver catalyst which decomposes the hydrogen peroxides to oxygen plus water. Before or after catalyst addition, the system is joined by the 10% bleed-stream of hydrogenated working solution leaving the after-cooler quinone reduction step. The quinhydrone in this working solution serves to absorb the oxygen liberated by hydrogen peroxide decomposition. Purified solution is then returned for further hydrogenation, thus completing one cycle.

Certain decomposition and oxidative products are unavoidably formed in the process and other contaminants (such as iron and nickel) enter the working solution from the equipment and catalyst. To remove these contaminants from the system, it is necessary to withdraw a small bleed-stream and to purify its contained anthraquinone and solvents by distillation, whereupon the recovered materials are returned to the process.

In this method of hydrogen peroxide production, replacement of degraded and lost 2-ethyl anthraquinone is an important cost item. Typical performance in commercial operation will yield 25 to 30 lb. hydrogen peroxide/lb. make-up ethyl anthraquinone charged to the cycle.

Hydrogen peroxide from alcohols

The partial oxidation of aliphatic alcohols for hydrogen peroxide has a major attraction by the simultaneous formation of a saleable carbonyl com-

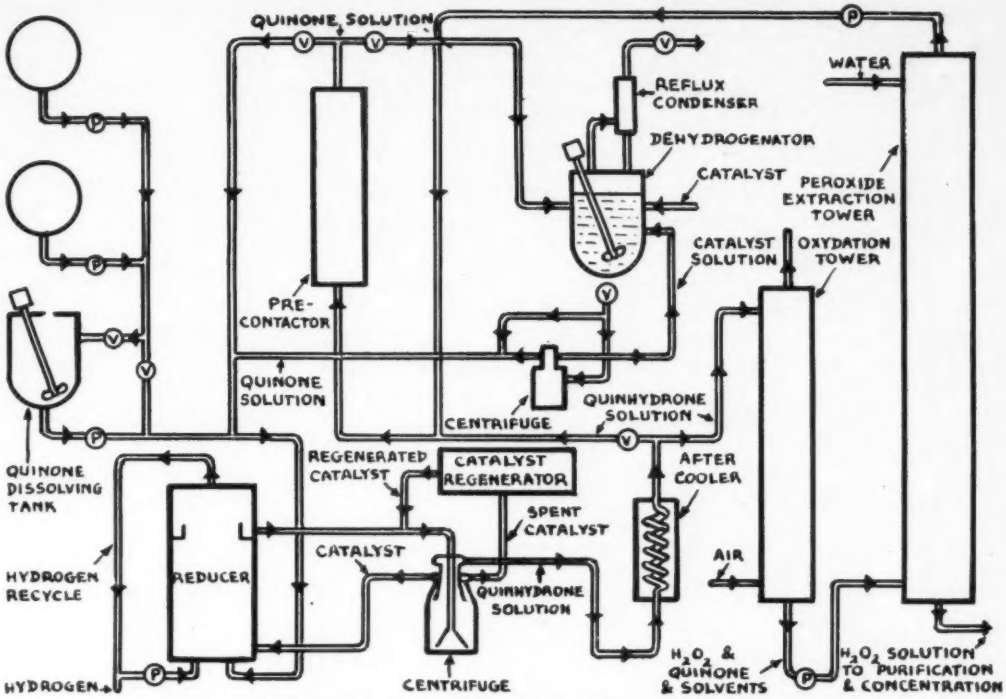


Fig. 1. Flowsheet for the ethyl anthraquinone process.

pound. Thus primary alcohols will yield hydrogen peroxide and aldehydes, while the oxidation of secondary alcohols leads to formation of ketones. At present, however, only secondary alcohols can be converted with industrially attractive yields.

For the case of isopropyl alcohol, the following main reaction applies:

$$CH_3 - CH(OH) - CH_3 \xrightarrow{O_2} CH_3C(=O) - CH_3 + H_2O_2 \quad \ldots\ldots\ldots\ldots (2)$$

The reaction may be carried out in either liquid or vapour phase. The former approach is generally believed to be practised at Shell Chemical Co.'s new hydrogen peroxide plant at Norco.

Liquid phase

Liquid-phase oxidation of secondary alcohols is carried out without an outside catalyst. Hydrogen peroxide itself serves as reaction initiator. It is introduced with the feedstock in a concentration of 0.5 to 1.0 weight% to avoid a lengthy incubation period.

Underlying the commercial process for liquid-phase oxidation of isopropanol to hydrogen peroxide and acetone is a method covered by N.V. de Bataafsche Petroleum Maatschappij.[1] This process requires the use of 80 to 95% oxygen as an oxidising agent. The conversion is carried out at 90 to 140°C. and at 200 to 300 p.s.i.g.

The correct choice of material for reactor construction is important. No material should be employed which promotes the decomposition of hydrogen peroxide such as iron, steel, nickel, etc. Good experience is reported for siliceous materials, aluminium, tin, and organic resins. Furthermore, it is desirable to use a reactor which has a relatively high ratio of volume to surface. Alcohol is fed to the reactor with hydrogen peroxide in initiator concentration. The most practical water concentration is governed by the composition of the isopropanol-water azeotrope formed in the alcohol purification stage.

The reaction product must be water-diluted before distillation to avoid occurrence of an explosive condition which stems from the simultaneous presence of concentrated hydrogen peroxide and organic compounds. Also added at this stage are stabilisers such as sodium metastannate and acetanilide.

Acetone and unconverted isopropanol are removed from the crude reaction product in a simple topping operation. The aqueous bottoms contain 6 to 10% hydrogen peroxide together with minor quantities of alcohols, ketones and aldehydes.

In liquid-phase oxidation, very high yields of hydrogen peroxide can be obtained by operating at a low conversion per pass. In one series of experiments, carried out at an alcohol conversion of 15%, hydrogen peroxide yield in the reaction stage was 93% of the theoretical. The overall yield, including purification losses, is reported to be 87% of converted isopropanol.

Vapour phase

Vapour-phase oxidation of isopropanol to hydrogen peroxide is also carried out non-catalytically. Air serves as oxidising agent. Typical alcohol/oxygen feed ratio for high efficiency is about 5 : 1.

The temperature range for the reaction is 350 to 500°C. But for a given set of conditions (feed alcohol, reactants ratio and contact time) an optimum temperature exists which

(*Concluded on page 97*)

A CPE Chemical Engineering Review

CENTRIFUGING

A review describing new developments in manufacture and exploitation of centrifuges used in various branches of industry

By T. A. Barker*

THE previous review in this series[1] covered a large number of new machines offered by centrifuge manufacturers. Since then, however, the trend in published work has been towards the exploitation of these machines in various processes and applications. Announcements by manufacturers have for the most part been concerned with the modification and improvement of existing models.

Theoretical and general

A review by Flood[2] gives an account of some recent developments in the U.S.A.; many of the references to applications have, however, been previously included in centrifugal reviews in this journal. The article includes a very useful summing up of available theoretical knowledge of centrifugal practice. It is admitted, however, that there are gaps in published information and that theoretical knowledge tends to be used to explain results obtained experimentally rather than to select and forecast the performance of a centrifuge which still remains, to a large extent, an empirical art.

A summary by Atkinson and Freshwater[3] of methods available for the separation of dispersed liquids in industrial liquid/liquid separation processes includes a section on centrifuging which is treated as a special form of gravity separation; within the section is a balanced appraisal of the two basic types of centrifuge available. Generally, however, the authors consider centrifugation as a special and rather expensive case of gravity settling. The review led to comment from Trowbridge,[4] who pointed out that many industrial separations are possible only by the use of centrifuges and quoted instances where centrifugal force produced effects other than accelerated settling.

An extensive article[5] on filtration includes a section on the centrifugal filter, and formulae are developed for calculating the pressure drop through the cake and for calculating washing rates. The work discussed is not new, but all relevant formulae are concisely presented together with worked examples.

An article by Allen[6] describes the separation of solids of differing densities using a suspending liquid of suitable specific gravity. Experimental data is given for the specific problem of separating particles of specific gravity 0.800 from particles with an sp. gr. spread of 0.7 to 1.0; the particles were in the size range of 105 to 210 microns. A kerosene of sp. gr. 0.8006 was used as the suspending media and it was possible to obtain three distinct fractions of solids, comprising light solids which collected at the centre of the centrifuge bowl, heavy solids on the bowl wall, and the intermediate fraction, sp. gr. 0.8, which remained suspended.

A new *Threshold* centrifuge is described;[7] it is a continuous centrifuge consisting of a long tube in the form of a spiral. The outer surface of the spiral has indentations which prevent the separated heavy component from being carried along the tube, but allows the liquid to weir over from section to section. Experiments are described in which the unit has been found suitable for the separation of blood, stomach washings and other biological materials.

New machines

Details were given in the previous review[1] of an increased range of De Laval high-speed intermittent solid discharging centrifuges for dealing with liquid/solid and liquid/liquid/solid separations. This range has been increased by introducing further developments of the basic machines.[8] These comprise the types BRPX 20700S and BRPX 21300S which are now available with pressure discharge of the light liquid and are constructed with all high-grade stainless-steel liquid and sludge contact parts. In addition the BRPX 21300H is similarly designed but has the additional feature of being suitable for handling liquids under hermetic conditions. This development is of particular interest in the brewing and allied fields where clarification of carbonated beverages without loss of CO_2 and contamination by bacteria is of major importance. As a class, these new machines also find extensive application in the food industries for the treatment of animal fats, tea, coffee, fruit juices, cider, etc., and with their self-discharging features provide a decisive step forward in the progress towards fully automatic continuous processing.

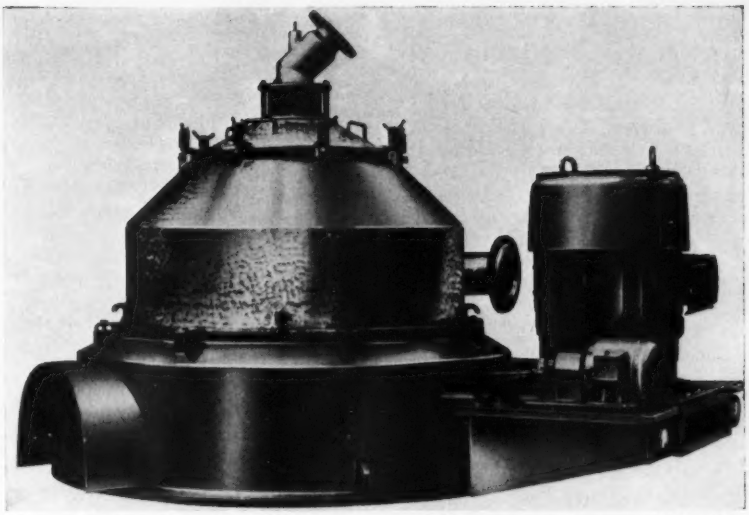
The De Laval WX 209-34 centrifuge has been introduced for the clarification of grinding coolants in machine shops. The unit has a bowl of 12 in. diam. and is driven directly at 1,425 r.p.m. from a 3-h.p. motor. To clean the centrifuge, it is rapidly decelerated by reversing the driving motor; this causes turbulence which scours the bowl wall and washes all the solids out. This cleaning cycle may be controlled by an automatic timing unit. The unit has a rated throughput of 750 gal./hr. of aqueous coolant and is suitable for installation in conjunction with small and medium-sized grinders.

Sharples'[9] range of machines has been extended to include the *Super Contessor*, a continuous scroll type with bottom discharge and conical screen rotor. Six different size machines are offered with 8 in. to 26 in. diam. rotors suitable for maximum feed rates from 55 to 20,000 gal./hr. and capable of handling from 1.5 to 60 tons/hr. of dry solids. Also of interest is a new pilot-plant nozzle centrifuge, the type DHL *Nozljector*, shown for the first time at the New York Chemical Show. The unit has a suspended-disc-type nozzle bowl and is available for pressurised operation if required. It is designed for maximum versatility in pilot-plant operations and provision is

**Alfa-Laval Co. Ltd.*

made for the introduction of wash and recycle liquors into the bowl.

A range of new basket machines[10] are offered by Power Installations Ltd. in a range of sizes from 18 to 60 in. basket diam. The machines are available for special duties with all contact parts of stainless steel. A Humboldt continuous vibrating centrifuge has been announced.[11, 12] The conical basket is vibrated axially at a high frequency while rotating. The combination of the centrifugal force and the vibrations cause the dehydrated solids to be continuously discharged from the machine. The two motions are driven separately and both may be adjusted to give the optimum results. A new rotary extractor developed in the U.S.S.R. has been reported.[13] It differs from existing types in that the flow through the rotor is initiated by the centrifugal force and not by external pumps. Experiments show that the machine has the efficiency of up to 6.5 theoretical plates, and it is proposed to employ the unit in the production of antibiotics, rare elements and other products which require a short extraction time.



'Super Contessor' handles high outputs of crystalline and readily separable solids.

Sugar

Progress in the field of sugar refining appears to be essentially of a mechanical nature, especially in terms of automating the basic batch operation, of centrifuging sugar crystals and of piecemeal improvements that are constantly being made in the design of centrifugals. However, reports have also appeared which have shown that considerable theoretical knowledge on sugar crystal centrifuging has been obtained. The most interesting development in the sugar field is the introduction of high-speed centrifuges as alternatives to thickeners and filters in ancillary processes.

New machines of the basket type have been reviewed.[14, 15] These are fully automatic with a pneumatic loading gate, motor-driven unloader and loading regulator for high-purity massecuites and a semi-automatic centrifuge for low-purity massecuites, respectively. Another new centrifugal[16] has a 27 × 42 in. basket operating at 1,000 to 1,200 r.p.m. It is driven by a 40-h.p. motor and the operating cycle may be controlled manually or automatically. Also detailed in patent specifications[17, 18] are two continuously fed centrifugals.

Mechanical improvements include[19] a device for the separation of molasses and wash syrups issuing from a centrifugal, asbestos cement shoes for friction clutch blocks,[20] an improved scraper arrangement,[21] an improved bearing[22] and modifications to electrical equipment.[23]

Jaskolski[24] reviewed the different types of centrifugals available to the sugar industry and described the basic design of each type. Tereshin[25] discussed the modern trends in the design of centrifugals for sugar massecuite separation. Test runs on Escher Wyss Type C-4-4 and Hein Lehmann *Hydromat* centrifuges are described and data given in two reports;[26, 27] test runs with different type screens and backing gauzes are also described.[28, 29]

From the operation point of view, Scherer[30] discusses all the problems involved in the automatic operation of centrifugals and describes an automatic charger which has a variable time cycle for different duties; Werner[31] also reports on trials on an automated plant.

A theoretical analysis of the behaviour of high-purity and final massecuites is made in an article by Honig and de Miguel[32] and formulae are developed for the rate of drainage of molasses and the proportion eliminated from the crystals. These enable optimum conditions of operation to be selected in terms of temperature, spinning time, etc.

Fundamental work on massecuite centrifuging has been carried out by Kot,[33] who has investigated the relationship between the thickness of syrup film on the crystal and the viscosity of the intercrystalline syrup; the work was developed from the laboratory to factory scale when a good correlation was obtained. Other work of a theoretical nature includes[34] the determination of massecuite separation periods in discontinuous centrifugals, which relates the times required for the removal of the molasses and the washing and steaming of the crystals. Also a study[35] of the gyroscopic phenomena in the movement of suspended centrifugals and a theoretical study[36] on the movement of particles in a centrifuge have appeared.

A high-speed centrifuge has been used[37] for the pre-clarification of mixed juices to remove starches to give a sugar of greater filterability. Factory trials using a De Laval QX 21030 nozzle-type separator gave an 80% removal of the starch, and the separated solids were discharged as a slurry containing 9% solids. It was reported that sand caused some erosion and blockage of the nozzles, but further trials are proposed using a rubber-lined bowl and with a greater degree of pre-screening. High-speed, nozzle-type separators have been used for the clarification of first saturation juice in a beet factory.[38] Two nozzle machines in parallel were used as an alternative to the conventional multi-tray settling tanks, and on the basis of these tests an installation to handle 500 tons/day of beet is proposed. Bemis[39] reports on work done on the desugarising of clarifier scums using a De Laval BRPX 209 self-opening separator and a patent specification[40] describes the desugarising of carbonation sludge.

An account[41] is given of the purification of 74° Brix β-molasses using a Westfalia high-speed separator, and the clarification of demineralised blackstrap molasses is described[42] with full analytical results.

Brewing and soft drinks

Few references to the application of centrifuges to the brewing and soft drinks field have appeared. One report, although only tentative, is of great potential interest and further developments should be of great importance. This is of a lecture on continuous brewing by Dummett[43] in which it was suggested that continuous centrifuges will be used for the removal of yeast from the ferment when the process is developed to a sufficiently large scale.

Tavernier[44] in a review of equipment for the industrial manufacture of apple juice and concentrated apple juice devotes a section to centrifuges. Similarly, Charley[45] covers centrifuges in a review of equipment used in the pure fruit juice processing industry.

Reports on plant in operation include De Laval hermetic centrifuges for the clarification of cider,[46] centrifuges for the clarification of blackcurrant juice[47] and, in a full description[48] of a modern citrus factory, centrifuges for the clarification of citrus juice and purification of citrus oil.

Soap

Continuous soap-making has been the subject of several articles and reviews and each of the methods using centrifuges are fully described. In the De Laval *Centripure* process[49, 50] soap-making is carried out continuously in a three-stage hermetically enclosed system, comprising the saponification of the fatty oils with lye, the washing of the soap mass with brine to recover the glycerine produced in the process and, finally, fitting the soap in order to effect further purification. To catalyse the saponification reaction, soap already formed is recirculated to the saponification section to which lye and fat are metered. The washing with brine is carried out countercurrently through three hermetic centrifuges, and the soap is finally fitted and separated in a fourth hermetic centrifuge. The system is suitable for all grades of soap. The Sharples process is described with other methods in a review article[51, 52] on the modern continuous methods for the production of soap. In this case the saponification is carried out countercurrently with centrifugal separation between each stage. In the first stage the fat is in excess to ensure complete utilisation of the caustic soda and, in the second stage, the lye is in excess to ensure complete saponification.

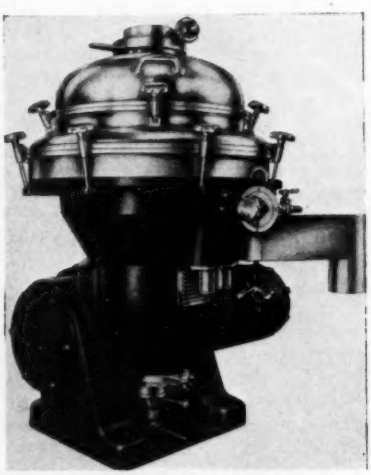
The Podbielniak continuous soap extraction process[53] employs Podbielniak *Soaprazon* contactors; the process is essentially a washing operation and a separate saponification section is necessary. In the extraction process described, raw soap is washed countercurrently with brine in the first-stage soap extractor. The curd soap is then fitted and the finished soap separated from the fitted curd soap in a second-stage *Soaprazon*.

A review article[54] describes soap-making processes and economically evaluates them in terms of energy and manpower requirements.

An ancillary to soap-making is the refining of glycerine, and Tosh[55] describes centrifuges for the recovery of salt from evaporated soap lyes. Suitable types are the automatic perforate basket centrifuge and the scroll conveyor horizontal bowl centrifuge.

Edible fats and oils

Continuous centrifugal refining of vegetable oils and centrifugal processing of animal fats have been of considerable economic importance when compared with the traditional batch methods; this point has been developed in an historical survey of refining methods by Robinson.[56] The increasing importance of these methods can be judged by the numerous references to new centrifugal processes appearing during the period under review. A patent specification[57] describes a two-stage alkali refining process employing centrifuges for the separation of the soap stocks. A new continuous olive-oil process is described[58] in which the pulp, after the removal of the kernels, is crushed, salted, kneaded and, after warming, diluted with water. The resultant mass is sieved and centrifuged to produce oil. In a very full review of refining methods for drying oils Mattikow[59] discusses several methods of refining using centrifuges, and quotes operating conditions and results from each. Alkali refining and centrifugal separation of the soap stock is discussed in a paper by Podbielniak,[60] who goes on to describe the use of Podbielniak centrifugal contactors for the water-washing of the neutralised oil.



De Laval self-cleaning separator with hermetic features.

Tall oil refining has been the subject of two reports,[61, 62] which describe continuous acidulation processes in which the metering of reagents, mixing and degasification is carried out continuously. The tall oil is separated in a nozzle-type separator which discharges three streams, a light phase consisting of separated oil, a heavy liquid phase of spent acid and a nozzle discharge of fine solids suspended in heavy phase liquid. A process is also described[63] for the production of pharmaceutical-grade sterols from tall oil. The tall oil pitch is fractionated with propane and the light fraction is saponified in methanol with caustic soda. After saponification the mass is chilled and the crystallised sterols are separated in a perforate basket centrifuge and washed with hot methanol.

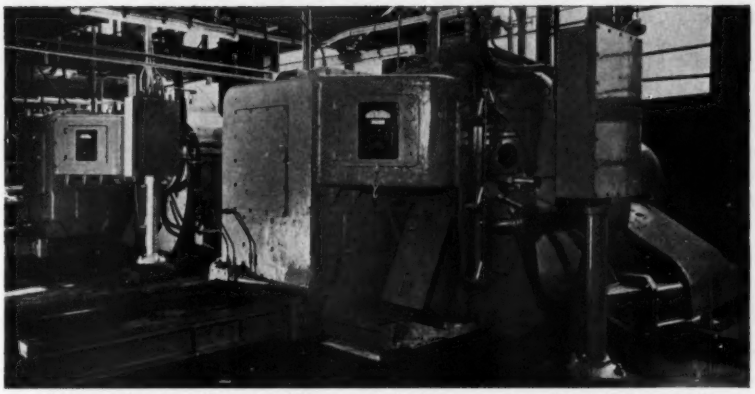
Further descriptions have appeared of two processes for the continuous low-temperature rendering of animal fats; both employ a combination of a horizontal-screw conveyor-type of centrifuge for the removal of low fat content protein, and a high-speed centrifuge for the purification of the fat.

In the Sharples process[64–66] the fat is first reduced to particles of $\frac{1}{2}$ to $\frac{3}{4}$ in. and these are heated in preheater tanks to temperatures up to 160°F.; the mass is centrifuged in a *Super D-Canter* when the bulk of the solids is removed with a low fat content. The fat stream is comminuted and injected with live steam in a second heating tank to raise the temperature to 180 to 210°F. A Sharples *Autojector* is then used for the purification of the fat. This centrifuge is of the self-opening type in which the automatic solid discharge is controlled by the build-up of solids within the bowl.

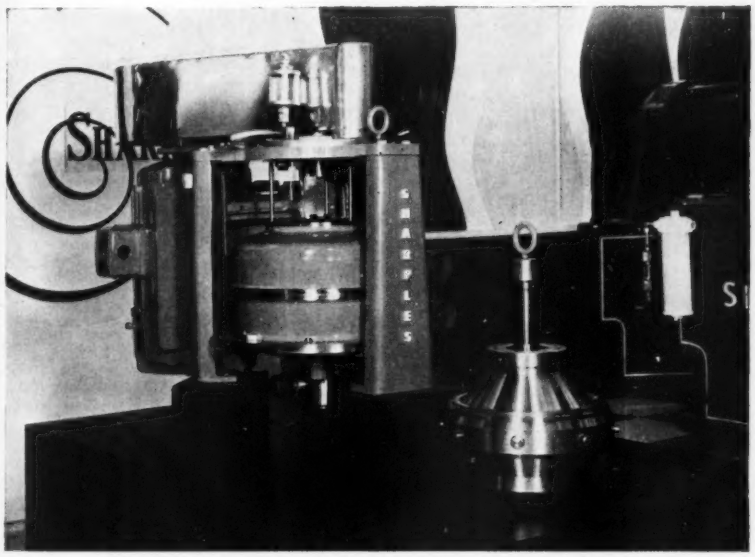
The De Laval *Centriflow* process[67] differs in several respects. The fat is broken down mechanically to a greater extent in the first instance and no secondary comminution is required. No holding tanks are employed in the system except for a small surge tank immediately after the mincer, thereby resulting in a very short processing time which enhances the quality of the fat. This is particularly important

when considering the higher temperatures employed in the second stage of the process. Thirdly, the fat purifying centrifuge used in the second stage is of the self-opening type which is operated externally, either manually or by an automatic timing device. For the De Laval process a comprehensive table of operating details, yields and analyses are given for various fats; yields are generally higher than 99% and often over 99.5% of the fat content of the raw material.

The De Laval[8] and Sharples[9] animal fat processes have both been modified to produce edible protein from the non-fatty tissue associated with raw fats.



Automatic ploughing centrifuge made by Thomas Broadbent & Sons Ltd.



Pilot plant nozzle separator 'Nozljector' made by Sharples.

A new process[68] is described for the recovery of organic distillates from vacuum deodorising plants in which a centrifuge is used to separate two liquid phases in the condensed vapours. Patents describe a centrifugal process for the recovery of wool grease,[69] a process[70] for recovering protein and oil from presswater obtained from animal materials and a method[71] for de-acidifying vegetable oils without spoiling their organoleptic characteristics by freezing and centrifuging off the solid fractions.

Centrifuges of various types suitable for fat recovery duties are described in one section of a review[72] of equipment for the recovery of fat and fatty products from raw materials. Wood[73] evaluates tubular, disc and basket centrifuges and discusses the uses of centrifuges in fish processing.

Oil and petroleum

The lack of references to centrifuges in petroleum and oil applications, paradoxically one of the largest sources of sales, shows, in itself, that the centrifuge is now well established in this field.

Beazley,[74] in an article discussing the filtration of engine lubricating oils, compares the characteristics of filters and centrifuges and shows that centrifuging, among other advantages, gives lower additive losses. The topic is developed by Vokes[75] in subsequent correspondence.

Associated with the centrifugal treatment of lubricating oils is the announcement[9] of oil pretreatment using expendable alkaline carbonate pellets for removing acidity.

The use of residual fuel oil in marine diesel engines is discussed in a paper by McClimont,[76] who emphasises the importance of adequate pretreatment of the oil. The two-stage centrifugal process, using purifier and clarifier centrifuges in series, is described. The first removes the water and coarser solids whilst the second removes the finer solids. Information[9] has also been released of the development of recycling nozzle machines for fuel and lubricating oil problems. Known as the *Gravitrol* system, it consists of a means of control external to the centrifuge which enables the oil/water interface to be constantly maintained in a static position within the bowl, irrespective of the specific gravity and water content of the oil. This system has been applied to the two-stage washing of heavy fuel oils for marine and land installations.

The pretreatment of gas turbine and free piston engine fuels is the subject of further reports. A two-stage process for removing the sodium compounds by water-washing is described.[77] The conversion of an oil-burning steam ship to gas turbine propulsion is also described[78] and reference is made to the centrifugal separator installations for both the fuel and lubricating oils.

Chemical and process industries

The outstanding feature of the references to centrifuges in the chemical processing industries is the prominence given to uranium processing. The most interesting article on this subject is by Groth,[79] who discusses the use of specially designed centrifuges for the enrichment of uranium isotopes. The process dates from initial experiments in 1895 and a full historical review is included. It appears from the author's conclusions that both capital outlay and processing

costs would be lowered with the centrifugal method of enrichment compared with other methods. The winning of uranium from its ores is discussed by several authors; Cronan[80] describes a process for refining the metal from phosphate rock. The element is present in the initial phosphoric acid solution to the extent of 0.01 to 0.02%. The acid solution is extracted with a 3 to 6% solution of capryl pyrophosphate in kerosene in a four-stage counter-current system with three centrifuges in parallel between each stage. The uranium is precipitated from the enriched solvent with hydrogen fluoride and this is centrifuged off in a basket centrifuge. A new extraction plant is described[81] employing Podbielniak centrifugal extractors. During a 15-sec. pass the extractor transfers 8 g./l. of U_3O_8 from 500 gal./min. of pregnant acid leach to 80 gal./min. of organic solvent. A second extractor further concentrates the U_3O_8 to 50 to 60 g./l. in an ammonium nitrate solution.

The recovery of uranium from unirradiated fuel elements is described at length.[82] The process involves initially a chemical dissolution in acid or alkali or alternatively an electrodissolution process. Centrifuges are used in the electro process when stainless-steel-uranium alloys are being dissolved to remove insolubles. In the alkali process for treating aluminium-uranium alloys, uranium is the insoluble material and is removed in a Sharples *Super* centrifuge.

Wells,[83] in a paper discussing the processing problems involved in homogeneous aqueous reactors, describes a projected process for removing uranium from process core fluid. The fluid is first centrifuged to remove solid corrosion and fission products; the uranium is then precipitated as a peroxide and centrifuged off. The process as yet has only been carried out on a laboratory scale with batch sizes up to 1 litre.

Plastic production is also prominent in the work reviewed. A centrifugal separator is used for the dewatering of polyvinyl chloride slurry,[84] continuous high-speed nozzle centrifuges operating under a pressure of 5 to 15 atmospheres are used for catalyst removal in a polythene plant,[85] and a solid bowl scroll conveyor type of centrifuge is used for the dewatering of polystyrene slurry prior to drying in a rotary drier.[86] The manufacture of synthetic fibres is the subject of an article by Doms;[87] a plant is described and mention is made of basket centrifuges which reduce the water content of the finished fibres to some 30%.

De Laval large sludge space clarifier.

The production of protein from grass and other vegetable materials for edible purposes is likely to become increasingly important as the world demand for food increases. A process is described[88, 89] in which vegetable material is subjected to impulse rendering in an alkaline solution when the cells are broken and the protein dissolved. Fibres are screened off and the protein precipitated with acid. The precipitated protein is concentrated in a nozzle centrifuge and finally dewatered in a basket centrifuge. Protein can also be obtained from soya beans by a similar process.[90] Oil-free soya bean flakes are dispersed in an alkaline solution which is then centrifuged, the clarified solution being treated with acid to precipitate the protein.

Small-scale experiments[91] have been carried out on the separation of the components of groundnuts to obtain protein, fat and carbohydrate meal. Partly defatted groundnuts were dispersed in an alkaline solution and centrifuged to separate the carbohydrate meal. The clarified dispersion was then separated in a liquid/liquid separator to separate the remaining fat. The residual solution was then acidified to produce protein and this in turn was centrifuged off.

In an alkaline process[92] for the extraction of rare earths from monazite ores, centrifuges are used for the separation of by-product tri-sodium phosphate crystals. A process[93] for the production of chlorothiazide, a new pharmaceutical, *Diuril*, employs basket centrifuges at several stages for the centrifuging of crystalline intermediate and final products. Phenol is removed from coke oven waste liquors by contacting with a light oil in a centrifugal contactor;[94] centrifuges are being used for the separation of nitroglycerine from residual acids[95] and, finally, a launderette extractor has been modified for the separation of a slurry of ammonium chloride in an organic liquid.[96]

Miscellaneous

The miscellaneous items to which centrifuges have been or may be applied shows their versatility and potentialities; in fact, there is almost no industry in which liquids are handled where the centrifuge, in some form or another, would not be of use. The centrifugal clarification of brine in bacon and pork pickling factories is the subject of one section of an article[97] describing equipment for the meat processing industry. Centrifuges have been applied to mining[8] where small centrifuges may be used for the continuous separation of sludges from sluice water for subsequent analysis, rapid analysis being particularly important with modern high-speed drilling techniques. Centrifugal clarifiers are described[98] for water treatment in the food industry in an article discussing water-treatment methods. The production of the more complicated aluminium component parts for the aircraft industry is carried out by contour etching[99] in which, after suitable masking, the unwanted aluminium is etched with caustic soda. Periodically, precipitated aluminium hydroxide and foreign metal sludge is removed from the etchant with a centrifuge. Also in the realm of production engineering Ellis[100] reviews methods for the reclamation of cutting oils and swarf recovery. The centrifugal units described include basket machines for swarf de-oiling and high-speed centrifuges for clarification of the oil.

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HYDROGEN PEROXIDE

(*Concluded from page* 91)

must be controlled within narrow limits.

The best performance has been reported at a conversion in the range of 60 to 80% of initial oxygen per pass. Typical contact time for such conversion is between 0.5 and 1.0 sec. (at NTP). Contact must be avoided with metals which will promote decomposition of hydrogen peroxide, such as iron or copper. According to Harris,[2] particularly good performance is obtained by the use of acidic enamels as internal reactor surfaces.

It is important that the reactor be quenched quickly to a temperature below 100°C. Water injection at this point has the dual advantage of providing quick cooling and of diluting condensed hydrogen peroxide below the point where an explosion hazard is created in the presence of organic materials.

The crude liquid reaction product is topped for the overhead removal of the alcohol-water azeotrope, which is recycled. At the same time, co-product ketone and other light boilers are taken off.

Hydrogen peroxide yield in vapour-phase oxidation at the most favourable reported conditions is about 0.7 mole/mole isopropanol consumed. Approximately 0.9 mole acetone are formed as co-product.

Product concentration and purification

Hydrogen peroxide obtained from petrochemical sources is marketed in three grades: 35, 50 and 90 wt.%. In each case, water is the diluent. Of late, interest has also developed in hydrogen peroxide of 97 to 100% strength which has military applications.

The standard commercial strengths (35 and 50%) can be obtained from the crude liquors by fractional distillation. There is no serious separating problem up to these concentrations. However, to avoid decomposition and occurrence of possibly explosive situations, the distillation is carried out under vacuum (100 to 300 mm. Hg) in the presence of inert construction material such as aluminium, and with the addition of small amounts of stabiliser such as sodium metastannate.

To concentrate hydrogen peroxide to a product in the range of 50 to 95%, rectification under high vacuum (40 mm. Hg abs.) may be used, and the use of special materials of construction such as high-nickel stainless steel or tantalum has been recommended.

Concentrations of hydrogen peroxide above 90% cannot be safely obtained by distillation. Instead, recourse is had to the use of fractional crystallisation for the final upgrading. Particular interest is attached in this connection to multi-stage continuous fractional crystallisation.

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The Design of a Packed Batch Distillation Column

Part 2

By F. Molyneux,* Ph.D., B.Sc.(Lond.), B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.Chem.E.

Criticism of design methods

The previous design† was an attempt to show how old, well-established correlations can and are being used industrially to solve one of the most common problems, *i.e.* the batch distillation to separate a pure component from a binary mixture.

A criticism of the methods used can be roughly classified into two groups: (1) Practical and (2) theoretical.

Under the first heading can be considered:

(*a*) Wall effects.
(*b*) Maldistribution or channelling.
(*c*) Heat of mixing.
(*d*) Thermal losses during fractionation.

The first two points can be considered as diametrically opposite in that, as the tower diameter increases, the wall effect decreases, but maldistribution and channelling increase. This channelling, or unequal flow of vapour and liquid through different sections of the tower, resulting in varying degrees of reflux ratio, has led to the infrequent use of towers of more than $2\frac{1}{2}$ to 3 ft. diameter, and to a suggestion by Rose[3] that, where diameters are required greater than this, the free area be made up of towers of 1 ft. diameter set in common top and bottom header boxes, but with each tower having its own liquor distributor from a ring main. It is, however, generally agreed that, provided the ratio of ring diameter to tower diameter does not exceed 1 to 8, that towers up to 5 ft. diameter can and are used without wall effect or channelling, provided also that a packed height of no more than 10 ft. is practised.

If the sections of packing are put in at 10 ft. height with a well-designed packing support and redistributor, these effects can be ignored in a column of the size being considered.

The thermal question ought to be considered in the final design, but in this case, where one is considering a transient differential operation, it is considered that these effects on a well-designed and -insulated tower would balance out, particularly with the still composition under consideration.

The theoretical criticisms to be considered are those relating particularly to the selection of the loading point and the effective wetted surface of packing. These are again inter-related and two recent papers[1, 2] give an adequate theoretical derivation of both.

Davidson[1] defines the loading point in a packed tower as that point at which standing waves start to form on the liquid film at points within the packing where the pressure gradient due to the acceleration of the gas is a maximum.

The loading point is the point of maximum mass transfer efficiency for the tower, and also the point of maximum wetted surface. Davidson derived the following equation:

$$\frac{1}{A}\left(\frac{G^2a}{\rho_g\rho_L g}\right) = 1 - B\left(\frac{La^2\mu}{\rho L^2 g}\right)^{1/3}$$

$$A\text{: Packing constant} = \alpha\left[\frac{15(1-\varepsilon)}{3\varepsilon-1}\right]^{1/2}\left[\frac{3(3\varepsilon-1)}{5}\right]^3$$

$$B\text{: Packing constant} = \frac{1}{(1-\alpha)^{1/3}}\left[\frac{5}{3(3\varepsilon-1)}\right]^{1/3}$$

which is a linear relationship between the dimensionless velocity head in the gas and the dimensionless liquid film thickness, and is suitable for correlating loading points.

The correlation is semi-empirical because constants $A + B$ have to be determined for each packing by measuring the loading point at two liquid rates.

The loading point at other liquid rates and for different gases and liquids can then be predicted. For the packing 2 in. × 2 in. × $\frac{1}{4}$ in. Raschig rings under consideration in this design, the constants are as follows:

A	B	ε	$\alpha = \frac{1.195A}{(1-\varepsilon)^{1/2}(3\varepsilon-1)^{5/2}}$
0.033	31	0.92	0.034

The resulting calculation gives a loading point generally in line with the 70 to 80% of flooding velocity normally assumed in distillation design calculations.

Davidson makes the point that at large voidages loading will start at the bottom of the tower and confirms the well-established practice of putting larger or graded, possibly stacked, packing at the bottom of the tower as being a good one.

Onda[2] gives an equation for the prediction of the maximum wetted surface at loading (a_w). This is the Fujita equation:

$$\frac{a_w}{a_t} = 1 - 1.02e^{-0.278(L/a + \mu)^{0.4}}$$

where a_w = Wetted surface area
a_t = Total surface area = 4.7 Dp
where Dp = Nominal diameter of packing in metres and a_t and a_w in sq.m./cu.m.

Onda extended the correlation of Sherwood and Holloway used in the previous design to the lower liquid flow rates used frequently in packed distillation towers and developed a more accurate correlation based on the total area of packing which for a simple Raschig ring is given by the formula above.

*Senior Lecturer in Chemical Engineering, Birkenhead College of Technology.

†*Part 1 appeared in last month's issue.*

The most suitable correlation developed by Onda is as follows:

$$k_L\left(\frac{\rho}{\mu g}\right)^{1/3} = 0.13\left[\frac{L}{a_t\mu}\right]^{1/2} \cdot \left[\frac{\mu}{\rho D_L}\right]^{-1/2}$$

k_L = Liquid side mass transfer coefficient, m./hr.
L = Mass flow rate, kg./sq.m./hr.
a_t = Total surface area of packing, sq.m./c.c.
μ = Viscosity liquid, kg./m./hr.
ρ = Density liquid, kg./c.c.
g = Gravitational constant in metric units

Further work reported by Davidson[4] derives a theoretical correlation for the liquid film mass transfer coefficient k_L and, when the theoretical results are compared with experimental, it was found that results from all practical packings agreed approximately with theory. Davidson thereby agrees with Onda's results in that, as far as liquid film behaviour is concerned, the important geometrical variables of a packing are its size and the wetted and interfacial areas.

Both Onda's and Davidson's results provide considerable evidence in favour of the Higbie Danckwert's surface penetration theory of liquid film resistance to mass transfer. This theory predicts that k_L, the liquid film mass transfer coefficient, should be proportional to $D_L^{1/2}$, where D_L is the liquid diffusivity coefficient, whereas the Whatman two-film theory predicts that k_L should be directly proportional to D_L.

The correlations derived by Davidson using the penetration theory considered the liquid film behaviour of a random-packed tower, the prediction being by a comparison of the packing with an idealised model:

(1) Composed of sloping surfaces set at random angles to the horizontal; and
(2) Set at random angles to the horizontal and with random wetted lengths up to the maximum length of the packing d.

In (1):
$$k_L = \frac{1}{0.244}\left(\frac{L}{\rho a_v d}\right)\frac{Gr^{1/6}}{Sc^{1/2}\,Re^{2/3}}$$

(2):
$$k_L = \frac{1}{0.1833}\left(\frac{L}{\rho a_v d}\right)\frac{Gr^{1/6}}{Sc^{1/2}\,Re^{2/3}}$$

For the range of liquid rates (L) from 0 to 8,000 lb./hr.sq.ft., the value of a, the total area for mass transfer per unit volume, can be put equal to a_t, the interfacial area.

For high liquid rates and relatively large packing (2 in. or over), the area for mass transfer a can be considered equal to the total dry area of the packing.

It was considered that equation (2) was the more suitable for the low liquid rates, and Reynolds Nos.

$$\left(\frac{2\pi L}{a_v\mu}\right)$$

encountered in distillation in packed columns and that, for the much higher liquid rates in absorption in packed towers, equation (1) may be more satisfactory.

a_v = Area of packing per unit volume, sq.ft./cu.ft.
a_w = Wetted area per unit volume, sq.ft./cu.ft.
d = Diameter of packing element, ft.
D_L = Liquid diffusivity coefficient of vapour in liquid, cu.ft./hr.
g = Acceleration due to gravity, ft./hr.^{2}
Gr = Grashof number $= \dfrac{gd^3\rho^2}{\mu^2}$
k_L = Liquid film mass transfer coefficient, ft./hr.
L = Liquid mass velocity, lb./hr.sq.ft.
Re = Reynolds number of random packing $= \dfrac{2\pi L}{a_v\mu}$
Sc = Schmidt's number $= \dfrac{\mu}{\rho D_L}$
μ = Viscosity of liquid, lb./ft.hr.
ρ = Density of liquid, lb./cu.ft.

Since most batch distillations in packed columns are liquid film controlling, it is felt that correlations of this type based on physical properties which can be obtained from nomograms published, *e.g.* D. S. Davies, 'Nomograms' (Reinhold Publishing), and O. E. Kharbanda, 'Nomograms for Chemical Engineers' (Heywood & Co.), will be of considerable value, if only for predicting the size of semi-technical columns which are usually required for experimental examination of full-scale plant factors.

In the present design this correlation given by Onda gave results generally in agreement with the extrapolated Sherwood-Holloway correlation which has been the basis of design for a considerable time in industrial practice.

It is also felt that, using basic two-film or surface-penetration theory, it should be possible to extend the method using fundamental relationships such as those developed by R. L. Bosworth ('Physics in Chemical Industry') to three-component and possibly multi-component distillation in packed columns.

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LIST OF SYMBOLS USED IN ARTICLE

a_v = interfacial surface area per unit volume of column
B = packing constant in Davidson's Correlation for Loading
D = mols or mass of product per unit time
D_L = diffusivity in the liquid phase
D_G = diffusivity in the vapour phase
d_c = column diameter
d = diameter of rings
ε = fractional voidage of packing
G = mass flow of vapour per unit time per unit cross-section
g = acceleration due to gravity
HTU_{OG} = height of transfer unit (overall vapour concentrations)
H = Henry's Constant $\dfrac{P_A}{X_A}$
K_g = overall mass transfer coefficient
$k_g k_L$ = film coefficients for vapour and liquid respectively
L = liquid flow in mols/unit time
M = molecular weight
m = gradient of equilibrium curve
N = number of transfer units
P = total pressure
Q = quantity of heat
R = reflux ratio
R_m = minimum reflux ratio
$\mathcal{J}K$ = gas constant
V = vapour flow in mols per unit time
x = mol fraction of component in liquid phase
y = " " " " " gas "
λ = latent heat per mol or per unit mass
μ_L = viscosity liquid
μ = viscosity vapour
$\rho_L \rho_g$ = density of liquid and vapour respectively
Re = Reynolds Group
Sc = Schmidt Group
Gr = Grashof Group

NUCLEAR NOTES

Sweden to build atomic power plant

The Swedish State Power Board is to build its first full-scale atomic power plant, the 100,000-kw. R4-EVA, at Björnö, on the Baltic coast, east of the city of Norrköping. The plant will be a surface structure, while the previously discussed underground location in central Sweden will be reserved for a forthcoming larger plant.

The choice of a surface structure, the Board says, permits of greater flexibility in designing the plant and will also cut the building time. The plant is scheduled to go into operation in 1967 under a new agreement concluded between the Board and the Swedish company, A.B. Atomenergi.

It is the second industrial reactor in the Swedish atomic energy development programme based on the use of natural uranium as fuel and heavy water as moderator, and with heavy water under pressure as coolant. Atomenergi will be responsible for the design of the reactor in collaboration with two Swedish companies, Asea and Nohab.

Major work on the building site is not expected to start until 1962.

Activated carbon

Extensive research and development on carbonaceous materials has led Union Carbide International Co. to standardise on petroleum - base materials for its *Columbia* activated carbon.

Coconut-shell charcoal has been regarded as the only acceptable raw material for processing into premium-grade activated carbon. Activated carbon produced from petroleum materials, however, is of comparable or superior quality, the study reveals, and cost reductions have made lower prices possible.

Dosimetry experiments

A formal agreement for the carrying out of dosimetry experiments at the Boris Kidric Institute at Vinca, near Belgrade, was signed in Vienna.

The experiments are designed to ascertain the exact neutron and gamma-ray doses received by some persons during a very brief period of uncontrolled run by the zero-power reactor at Vinca in October 1958. They are needed to evaluate fully the novel medical treatment, given the persons involved, at the Curie hospital in Paris.

The Yugoslav Nuclear Energy Commission will place the zero-power reactor at the Boris Kidric Institute at the International Atomic Energy Agency's disposal for the experiments and the necessary preparations which will be the responsibility of the agency.

The agency will publish a complete scientific report on the results of the experiment.

U.S.-French co-operation

Plans to form a joint company to design, build and market nuclear reactors in France and the French Union have been agreed on by Atomics International, Societe Alsacienne de Constructions Mecaniques and Chantiers de l'Atlantique (Penhoet-Loire).

The proposed Franco - American company, to be called Dynatom, would build power and research reactors, with special emphasis on sodium graphite and organic-cooled-power types and solution-type research reactors.

First action pending formation of the new company is a proposal to build a 165 electrical Mw. organic-moderated reactor plant for Societe Franco-Belge de la Centrale Nucleaire des Ardennes, which is being formed by a group of French and Belgian utility companies. The nuclear power plant would be built near Chooz, France, under the Euratom programme.

Atomics International would provide Dynatom with technical assistance and the training of technical personnel.

Societe Alsacienne de Constructions Mecaniques was one of the first French companies to engage in nuclear activities. It was the principal contractor of the two large plutonium production reactors G2 and G3 recently completed at Marcoule, France.

Under a contract with the Commissariat a l'Energie Atomique, experimental work is under way on a sodium heat-transfer loop and several studies are being performed concerning the power station EDF-1 of Electricité de France, and the pressurised water reactor and boiling water reactor for the merchant marine.

Chantiers de l'Atlantique (Penhoet-Loire) is a shipbuilding company. As principal contractor and architect engineer, the company constructed for the French Commissariat a l'Energie Atomique the high-flux, heavy water reactor EL-3 at Saclay and the PEG experimental reactor.

For the French Navy a design study was made of a propulsion reactor for the submarine Q244. For the merchant marine a design study was completed for a 40,000-ton nuclear-propelled tanker.

The two French firms will be contracted in the near future by the Commissariat a l'Energie Atomique to act as architect engineer for the *Rapsodie* fast breeder reactor.

Insurance Act

The Nuclear Installations (Licensing and Insurance) Act comes into force on April 1. Under the act licensed operators of atomic reactors are under an absolute liability for any hurt to any person or damage to any property due to the escape of radioactivity. The advantage of this development from the point of view of the general public is that they will not be required to take special insurance measures to safeguard themselves against personal injuries or damage to their property due to radioactive contamination arising from the use of atomic reactor installations in Britain. They will be entitled to claim compensation direct from the operator of an installation, who will be required to effect an insurance of £5 million to meet third party claims arising out of radiation hazards or, alternatively, have ' available sufficient funds at all times ' to meet such liabilities up to that amount.

Suitable third party insurance will be available to reactor operators, who will be licensed by the Government, from the British Insurance (Atomic Energy) Committee, which represents the British insurance market comprising the insurance companies and Lloyd's underwriters.

The Act is concerned only with radioactivity from nuclear fuel or waste. It does not apply to ionising radiations from radioisotopes, *x*-ray machines and particle accelerators. Those who use them in industry, agriculture, medicine and scientific

research generally will still need to make their own separate insurance arrangements and will find little difficulty in doing so.

The British Insurance (Atomic Energy) Committee mobilises into a single atomic energy insurance pool the combined resources of the British insurance market. As well as being in a position to provide third party insurance of £5 million for each reactor installation, the pool can offer cover running into many millions of pounds in respect of physical damage to the installation itself. It is already providing insurance for a number of reactors in the U.K. and overseas. It does not provide insurance against damage or injury caused by radioactive fall-out from the explosion of nuclear bombs or similar devices.

Remote handling

A system of stereoscopic closed-circuit television has been developed by E.M.I. Electronics Ltd. to meet the requirements of nuclear plants and other establishments where dangerous materials have to be manipulated remotely.

The equipment consists of two camera channels mounted side-by-side and arranged to relay pictures on to two monitors. The pictures from these are then superimposed on each other by means of a mirror and polarised glass to form a single image.

When viewed through polarised spectacles this produces a three-dimensional picture.

Proton synchrotron

The 25-GEV proton synchrotron of the European Organisation for Nuclear Research has now been put into operation. Towards the end of November protons were accelerated up to 24-GEV kinetic energy and, a few weeks later, after adjustments had been made to the shape of the magnetic field at field values above 12,000 gauss by means of pole face windings, the maximum energy was increased to 28 GEV. The intensity of the accelerated beam of protons was measured as 10^{10} protons per pulse and there was no noticeable loss of particles during the whole acceleration period up to the maximum energy. The C.E.R.N. proton synchrotron has thus fulfilled the expectations of its designers and the hopes of the 12 European countries that have supported the work for the past six years.

£ s d

CHEMICAL PLANT COSTS

Cost indices for the month of January 1960 are as follows:

Plant Construction Index: 180.1

Equipment Cost Index: 166.6

(June 1949 = 100)

£ s d

I.A.E.A. research grant

The first research grant under the exchange and training programme of the International Atomic Energy Agency has been awarded to Dr. R. P. Agarwala, of India, who will undertake 12 months research in the field of solid-state physics and chemistry at the Massachusetts Institute of Technology, U.S.A.

I.A.E.A. research grants are awarded mainly to scientists with considerable research experience, who are already working in their own countries on a promising line of research which cannot be developed fully there because of lack of equipment or laboratory facilities.

Radiation laboratory

Vitro International (U.S.A.) has been awarded a contract by the Indian Government for the design of a $4-million high-level radiation laboratory at the Indian Atomic Energy Department nuclear centre, Trombay.

One of the largest integrated radioactive research laboratories in the world, it will include facilities for radiochemistry, radioisotope and hot metallurgy operations. A special feature will be a number of hot cell areas for radiation experiments with plutonium and other highly toxic materials. Special shielding windows will provide for safe observation of experiments.

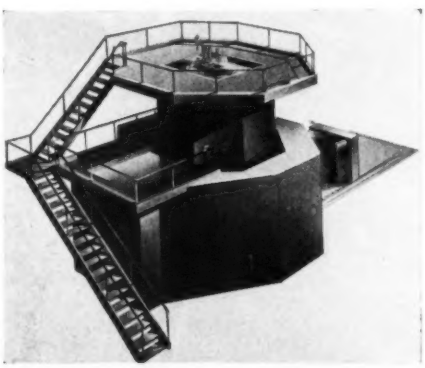
Denmark's research reactor critical

The Danish Atomic Energy Commission have confirmed that their nuclear research reactor supplied by Head Wrightson & Co. Ltd. at the atomic research centre, near Copenhagen, became critical.

Head Wrightson have been awarded contracts for six 10-Mw., enriched uranium, heavy water-moderated research reactors, three in the U.K., one in Australia and one in West Germany. The Danish reactor, PLUTO, will enable essential research to be conducted on the testing of materials under the effects of irradiation.

Britain's sixth nuclear power station

The Minister of Power has given his consent to the Central Electricity Generating Board for the construction of a nuclear power station at Sizewell, Suffolk. The station is intended to be of 650,000-kw. output capacity and will be the sixth nuclear power station in the Board's programme.



TRIGA MARK II

The above-ground *Triga Mark II* version of the *Triga* was developed by the general atomic division of General Dynamics Corporation to make available to universities and research institutions an economical reactor combining a thermal column and beam tubes with large-scale irradiation facilities adapted to research in almost all areas of nuclear work.

The core, like that of the below-ground version, is at the bottom of an open pool 21-ft. deep and shielded by a 16-ft. vertical column of water. Radial shielding is provided by the surrounding water and 7.5 ft. of ordinary concrete. Experimental and irradiation facilities include those of the below-ground version, plus a graphite thermal column, four horizontal beam ports and a bulk-shielding experimental tank.

Vickers-Armstrongs have been licensed to manufacture this reactor in the U.K.

A quarterly summary of recent happenings in the United States

Pennsalt Chemicals Corporation has concluded negotiations with Cabot, Cabot & Forbes to purchase a 50-acre site in the King of Prussia Park for construction of a technical centre which will ultimately represent an investment of $6 million. This park, at the Valley Forge Interchange of the Pennsylvania Turnpike, is one of 14 industrial parks developed by Cabot, Cabot & Forbes along the Eastern Seaboard.

In announcing the new purchase, Pennsalt president said that it will permit an orderly expansion of Pennsalt's growing needs for technical facilities; for research, development and technical service.

There is to be campus-type arrangement featuring a central mall. The first building will be a two-storey laboratory which will be devoted to product development and technical service on Pennsalt's proprietary chemicals for the metal-working industry, laundry and dry cleaning trade, food and dairy plants, as well as consumer products for the farm and home. The *Isotron* refrigerant and aerosol propellant technical group will also occupy expanded facilities in this new building.

$

A method to detect the presence in bone of yttrium—a strongly radioactive fall-out product—was described by C. L. Grant of the Rutgers University Agricultural Experiment Station, New Brunswick, N.J., at the twelfth annual Scientific Conference of the American Society.

Yttrium-90 is the decay product of strontium-90, the radioactive element that can cause bone cancer. Though yttrium-90 has a shorter life the intensity of radiation is considerably greater than that of strontium-90. Whether or not yttrium has the bone-seeking tendency of strontium is not yet known. The new technique is capable of detecting 100 p.p.m. of yttrium which has been previously added to bone samples. By using the method of ion exchange, the metal is separated from the bone by passage through a column of synthetic resins. Then, with the help of an emission spectrograph, the trapped yttrium is burned in a high-voltage discharge and the subsequent emission of light is polarised.

The procedure allows a ' fairly precise determination of the amount of yttrium present.'

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The American Chemical Society has established a division of public, professional and member relations as a part of the headquarters staff in Washington. The new division will report to executive secretary A. H. Emery. J. H. Stack, managing editor of the society's news service, has been appointed director. R. Avery, assistant managing editor of the news service, becomes managing editor. The news service has been made part of the new division but remains in New York. D. A. H. Roethel has been named manager of the division's office of professional and Government relations. R. H. Neuman has been appointed manager of the office of information services, a third unit of the new division.

$

The Texas Atomic Energy Research Foundation and General Dynamics Corporation are to award six research fellowships this summer to Texas graduate students for work at General Dynamics general atomic division in San Diego where the world's first and largest privately-financed programme in controlled thermonuclear research is under way.

The $10-million programme is sponsored jointly by the Foundation, composed of 11 investor-owned electric utility companies operating in Texas, and general atomic division. Established in April of 1957, the theoretical and experimental programme is aimed at a more complete understanding of plasma physics to point the way towards controlling and sustaining a fusion reaction.

Recipients of the six summer research fellowships at the John Jay Hopkins Laboratory for Pure and Applied Science will assist General Dynamics' research workers in theoretical and experimental research in plasma physics, including experiments with pinch discharges and shock tubes, plasma stability, temperature and pressure measurements, and optical and mass spectroscopy.

Experimental work in the controlled fusion programme at the laboratory is focused on the basis of problems of raising the temperature of ionised gases (plasma) to a range from 100 million to 1 billion degrees—several times that of

the centre of the sun—and keeping them suspended in a magnetic field so they will not touch the walls of the container.

One of the major experimental devices in use at the laboratory is a large doughnut-shaped instrument called a torus. With the torus, attempts are being made to achieve the temperatures necessary for a fusion reaction through the use of a storage condenser bank capable of delivering 50 million kw. of instantaneous power for experiments. Supporting the torus experiments are two linear pinch assemblies and a shock wave and plasma projection facility.

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Columbia University's School of Engineering will offer a new degree of nuclear engineer beginning with the 1960-61 academic year next September.

The new degree is for professional engineers who wish to practice nuclear engineering but who do not need a doctorate.

It will be called the 'N.E.' degree and will be 'more advanced than a Master of Science but less rigorous than a doctorate.'

The degree does not require a thesis if the student submitted a thesis for a Master's degree. Comprehensive examinations are required, however.

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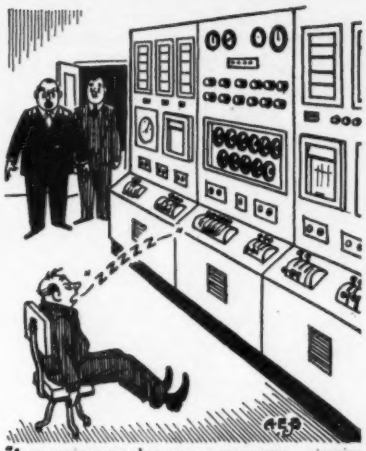
In the use of gaskets and seals for water or steam systems, it is necessary for a rubber technologist to choose the composition that will give the best service for an extended period of time. Because data are not always available, the technologist is often required to estimate the changes in mechanical and physical properties of the seal while in use. On exposure to different types of liquids, the mechanical properties of a polymeric composition are generally found to be proportional to the degree of swell (change in volume) caused by the liquid. It should be possible to predict the water-absorption and swelling characteristics of polymer-filler systems, provided the water absorbed by polymer and filler is additive and the volume of water absorbed by a unit volume of filler is independent of the type of polymer.

A study was undertaken by S. Palinchak and W. J. Mueller of the Battelle Memorial Institute to measure the absorption characteristics of different polymers both as gum and filled vulcanisates and to determine the influence of fillers on water absorption

Comical Engineering Corner



"AND EVERYTHING'S FULLY AUTOMATIC—EXCEPT, OF COURSE, SIMPKINS HERE."

and swell of the polymers. It was hoped that an absorption factor could be assigned to each filler and this factor used in development of compositions to meet specific needs.

Results suggest that type of curing system may have little effect on water swelling as long as electrolyte materials are not added. An electrolyte type of curing material such as benzal chloride used for vulcanisation of the butadiene-vinyl pyridine copolymer greatly enhances the water absorption of the calcium silicate filler, but only slightly increases swell for a composition containing an HAF black.

All data point to electrolyte impurity as a cause of high absorption of water by polymers and fillers.

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A massive machine capable of gripping the ends of a 60-ft.-long plate of thick, high-strength aluminium and stretching its length by as much as 4 ft. has been put into operation at the Ravenswood, W. Va., works of Kaiser Aluminium & Chemical Corporation.

The plate stretcher—installed in a concrete pit 120 ft. long, 32 ft. wide and 15 ft. deep—has a pulling force of 30 million lb., or nearly twice that of the largest stretcher currently in the metals industry. It can handle aluminium alloy plate up to 6 in. thick and 13½ ft. wide, within an overall cross-section area limit of 640 sq. in.

The purpose of the stretcher is to refine the internal structure of the metal by equalising stress distribution in heat-treated alloys and welding alloys which are gaining increasing use in a wide variety of industrial and structural applications.

The weldable aluminium alloys introduced in the past few years are seeing growing use in marine construction, in the chemical process and petroleum industries for tanks and process equipment, and in railroad equipment such as tank cars. One of the most rapidly growing fields of application for these alloys is for processing, storage and transportation of liquid methane, oxygen, nitrogen and hydrogen.

To handle the tremendous forces involved in a 30-million-lb. stretcher, a number of unusual features were incorporated in the design of the stretcher which was undertaken by the firm's advanced engineering design section.

The machine is supported, without a guiding frame, on tracks and no effort is made to hold it in a rigidly fixed alignment. Individual heads are supported on each side by eight railway-type car wheels on a double track. Innovations incorporated in the hydraulic system keep the two sides of the machine parallel and completely independent of the load in the gripping jaws.

The gripping heads are of unconventional design. There is a top and bottom head, each weighing 132 tons, held together by six forged tie bolts, 15 in. in diam. and 15 ft. long. The stretching force is provided by 6,000 p.s.i. hydraulic pressure on two 56-in.-diam. cylinders.

Some of the individual components of the stretcher are of massive size—each half of a head, made of cast steel, weighs 264,000 lb., and each of the two solid columns weigh 145,000 lb. Design techniques, however, have made it possible to keep total weight of the machine to less than 3 million lb. The stretcher was built for the company by Hydraulik GmbH., Germany.

$

To increase production capacity of caustic soda, caustic potash and chlorine at its Niagara Falls plant, Hooker Chemical Corporation plans to invest about $10 million in a new installation of Hoeschst-Uhde mercury-type electrolytic cells during 1960-61. This expansion is designed to meet increasing demand for these chemicals both for direct sales and for manufacture of other chemicals.

The cell installation should be completed by late spring of 1961 soon after the first power is expected from the Niagara project of the Power Authority of the State of New York.

World News

SWEDEN

New plant for trichlorethylene

The Uddeholm Co. steel and timber combine in central Sweden has recently taken into use a large plant for production of trichlorethylene (TRI) and perchlorethylene at its Skoghall works. It has a capacity which will suffice to cover Sweden's entire needs of these cleaning media, in addition to permitting of a sizeable export. The plant is fully automated. Based on the 45-year experience of the company in making chlorine for use in its own pulp industries, Uddeholm started out making the two new products on a smaller scale after the end of World War II.

The fact that Uddeholm is practically self-supporting in electric energy, having several water-power plants of its own, is a contributing factor to the competitive power of this new enterprise, which requires large quantities of energy. The company points out that, thanks to rationalisation and cheap energy, the prices charged today for trichlorethylene and perchlorethylene are hardly higher than 10 to 15 years ago.

Automatic instruments supervise the dosage of raw materials, and they also check that conditions of pressure and temperature, etc., are being kept at a stable level. This is important for maintaining a high and even degree of purity of the finished product, which in turn makes it possible to store it longer.

BELGIUM

Lithopone plant

S.A. Produits Chemiques de Nieuport have completed the modernisation and enlargement of their lithopone plant. The capacity for the production of *Red Seal* 30% zinc sulphide lithopone has been trebled.

CANADA

Petrochemical plant

Construction work was recently begun by Humphreys & Glasgow (Canada) Ltd. on a major extension to B.A.-Shawinigan's petrochemical plant at Montreal. B.A.-Shawinigan Ltd., a joint subsidiary of Shawinigan Chemicals Ltd. and of the British American Oil Co. Ltd., manufactures synthetic phenol and acetone *via* the cumene process together with other derivatives of these products.

The contract involves additions and modifications to the existing process and service units including foundations, structures, piping, instrumentation and other items making up a 'turnkey' project.

Process design work began in November, and the new plant is scheduled to be in operation by May 1. Humphreys & Glasgow (Canada) Ltd. is an associate company of Humphreys & Glasgow Ltd. of London, an organisation established in eight countries.

BRAZIL

Plastics raw materials

The Belgian firm of Union Chimique Belge S.A. will import equipment for producing chemicals for the firm of Ucebel Produtos Quimicos Ltda. A Sao Paulo firm, Produtos Quimicos Elekeiroz, has a 50% share in Ucebel. The firm will manufacture raw materials for the plastic industry.

BULGARIA

Fertiliser plant

A start has been made with the building preparations for the erection of the new giant nitrate fertiliser plant near Stara Zagora, Bulgaria. The first production of ammonia silitrate will start by the end of 1962.

In 1964 the plant will be producing 440,000 tons of artificial fertiliser p.a. The installations are being supplied by the U.S.S.R.

To meet the plant's power requirements, a 30,000-kw. power station is being built nearby, together with a plant for enriching the lignite coal of the East Maritsa basin.

MEXICO

Synthetic rubber

Petróleos Mexicanos is reported to propose investing 72 million pesos in the construction of synthetic rubber plants in Tampico, Tamaulipas, Mexico.

The new industry is intended to go into production at the beginning of next year.

FINLAND

Large boiler

Sulphate pulpmakers, Kemi OY, of Karihaara, has placed an order for a $2-million boiler plant with the Götaverken shipyard and engineering workshop of Gothenburg. The plant is reported to be the largest of its kind in the world, and will have a capacity of 700 tons/24 hr. of pulp.

IRAN

Catalytic reformer

A £3.5-million catalytic reformer, able to process 1 million tons of oil p.a., is to be built at Abadan over the next two years by the Consortium's Iranian Oil Refining Co.

The plant will produce high-octane components essential for manufacture of premium-quality motor gasoline. Products from Abadan also supply the growing Iranian internal market, which has increased during 1959 by 17% to over 3 million tons p.a.

NEW ZEALAND

Aluminium mill

Subject to the consent of the New Zealand Minister of Lands, and the Manukau County Council, the Northern Aluminium Co. Ltd., of England, will built its £2-million aluminium fabricating mill on a 30-acre site in Wiri, 14 miles south of Auckland.

The mill will provide employment for about 250 people and is expected to begin production early next year. Round-the-clock operation will yield output of 5,000 tons and a turnover of £1.5 million p.a.

ISRAEL

Phosphates plant

The Ministry of Development and the Negev Phosphates Co. Ltd. are working on a proposal for the establishment of a second phosphates plant at the phosphate fields which were discovered at Ein Yahav, 55 km. south of Sodom. I£200,000 has been allocated by the Ministry for preliminary research on the project.

The quality of the Ein Yahav phosphates is under investigation, as are the quantities that can be extracted from the fields at various stages.

HOLLAND

Titanium white

The Billiton Tin Co. and the Albatros Sulphuric Acid & Chemical Works have jointly founded a new company for the production of titanium white.

A 30-million-guilders factory will be erected in the Botlek area, near Rotterdam, with an initial output of 10,000 tons p.a. of titanium dioxide.

FRANCE

Caustic soda plant

Société Krebs & Cie. has completed installation, for the Dhrangadhra chemical works near Tuticorin, of a caustic soda plant of 30,000 tons and of a sodium carbonate plant at Dhrangadhra.

WHAT'S NEW

Plant • Equipment • Materials • Processes

CPE reference numbers are appended to all items appearing in these pages to make it easy for readers to obtain quickly, and free of charge, full details of any equipment, machinery, materials, processes, etc., in which they are interested. Simply fill in the top postcard attached, giving the appropriate reference number(s), and post it.

Watching the flow

A simpler, smaller form of their sight flow indicator is offered by B. Rhodes & Son Ltd. In its standard form the indicator has a metallic body, usually of gunmetal, brass, cast iron or steel and with ends suitably screwed or flanged for the pipe connections. Internal ports drive the flow of liquid past a nylon paddle wheel which is free to run on a stainless-steel shaft. The upper portion of this paddle wheel appears within a glass dome through which the paddle wheel revolving can be readily seen. Should flow cease the paddle wheel will immediately stop revolving, indicating the cessation of flow. **CPE 1451**

Cessation of flow is indicated by the stopping of paddle seen through the glass dome.

Bellows flowmeter

A new bellows-type flowmeter featuring automatic temperature and static pressure stabilising is offered by Honeywell Controls Ltd.

The new flowmeter is said to operate efficiently with ambient temperatures between −40 and +250°F. It incorporates a rapid pulsation damping device.

The instrument, which is suitable also for liquid level measurement, is claimed to have an accuracy of ±0.5% full-scale differential pressure. Positive overload protection is provided.

Fifteen different ranges from 0 to 20 in. water to 0 to 400 in. water are available; only the simplest component change is necessary for range changing. A large bellows system and torque tube assembly give high torque and power output for the operation of additional elements.

The flowmeter can be used in conjunction with integrally mounted or remote reading indicators, recorders or controllers. Automatic flow totalising on a six-digit counter can also be incorporated.

The bellows and all parts of the assembly exposed to the process fluid are of stainless steel.

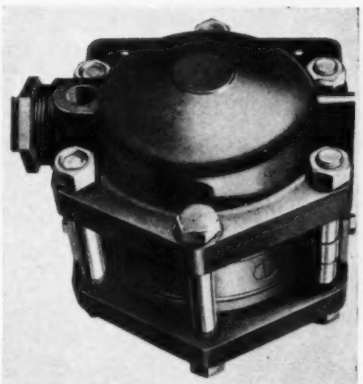
Ease of installation is assured by pressure connections for vertical and horizontal piping which can be positioned at either the top or the bottom with no change of parts. **CPE 1452**

Air pipeline filters

Small compressed-air pipeline filters made by Vokes Ltd. are now available with alternative elements giving two degrees of performance. They have been designed to give protection to air-using equipment by the continuous removal of abrasive pipe scale, other solids, and corrosive moisture from the supply air.

The standard general-purpose element, the *VAF* 57, is for applications where removal of water or oil mist and grit is required where the concentrations are average. The alternative element, the *'D' Pak*, is for applications where oil or water mist removal is of primary importance and a high degree of purity is essential.

Both element assemblies are interchangeable within the standard case. This will permit the user to improve or



Bellows flowmeter with automatic temperature and static pressure stabilising.

relax on the standard of performance.

A die-cast, light alloy head-casting houses the filter element, which can be removed by unscrewing one nut. A ribbed clamp ring mating with a thread on the head is employed to fit a transparent plastic bowl available in two different capacities. The standard unit is capable of operation at pressures up to 150 p.s.i. Units for operation at pressures in excess of this and up to 250 p.s.i. are supplied with metal bowls. **CPE 1453**

Thermosetting adhesive on tape

It is claimed that a new pressure-sensitive tape with a thermosetting adhesive overcomes the problem of deterioration when stored. Under normal storage conditions the tape is said to have a shelf life of six months or more.

In use, once the adhesive is set it is no longer pressure sensitive and the tape therefore can be said to give a permanent bond. The film and adhesive are then unaffected by temperatures of up to 180°C.

The tape is recommended for incorporation in electrical assemblies which are heated in manufacture or during service.

It is available in 72-yd. rolls, on 3-in.-diam. cores, in a variety of widths ranging from $\frac{1}{4}$ in. upwards. Makers: Gordon and Gotch.

CPE 1454

Fill in and post the reply-paid card for details of any items in these pages, making sure to quote the correct 'CPE' reference number.

Belt weighing machine

A new belt weighing machine is offered by Merrick Mfg. Co. Ltd. The unit will fit to horizontal or inclined conveyors having either flat or troughed idlers, and will totalise the weight of material passed over the conveyor.

The heart of the *S.V. Weightometer* is a mechanical integrator which continuously multiplies two varying quantities, which are the ever-varying load on the conveyor, which often is subject to extreme and rapid fluctuations, and a slightly varying belt speed of the conveyor. The speed of any conveyor, whilst usually considered as constant, in reality varies slightly with the load and, in weighing, unless these conditions are taken into consideration, any final results will be erroneous.

The machine can be supplied to suit any conveyor capacity and belt speed.

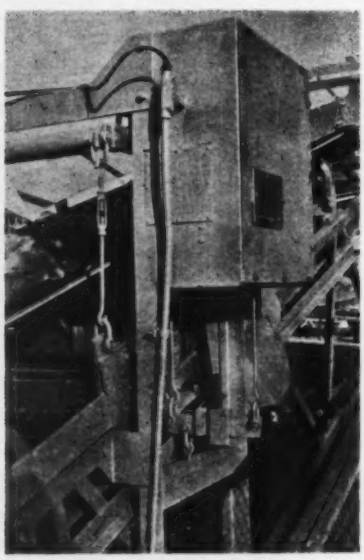
All types of instrumentation are available with the machine, both electronic and pneumatic. The weight recorder, which shows the weight of material passed over the conveyor, can be at a remote position.

Advantages claimed for this machine lie in the ability of the unit to be fitted to existing conveyors with a minimum of modification to the structure, together with simplicity of design and low headroom requirements.

The accuracy is stated to be $\pm\frac{1}{2}\%$ of true weight passed when the conveyor is operating at full load conditions. **CPE 1455**

Non-catalytic oil cracking

A new process for the gasification of petroleum oil, which is continuous and does not employ catalysts, is offered by the Incandescent Heat Co. Ltd. Cracking heat is supplied by burning oil and waste products in a compact and simple furnace setting. The oil to be gasified is injected, together with steam, into a system which is specially designed to enable a uniform and precise control of cracking temperatures to be exercised. By these means the production of unwanted by-products (particularly carbon and tarry condensates) can be kept to a minimum; more particularly the calorific value of the gas produced can be varied continuously in the range 500 to over 1,200 B.Th.U./cu.ft.



Belt weighing machine.

The gas is interchangeable with natural gas or coal gas of similar calorific value. Results obtained with a heavy distillate oil indicate that this system can be operated economically over a wide range of throughputs.

CPE 1456

Measuring fall-out

The *Gammograph*, made by Electronic Instruments Ltd., is an instrument developed to measure continuously the fall-out of gamma radiation such as in the vicinity of a nuclear power station. Powered by an ordinary car battery and weather-proof, it can work continuously for one month without attention.

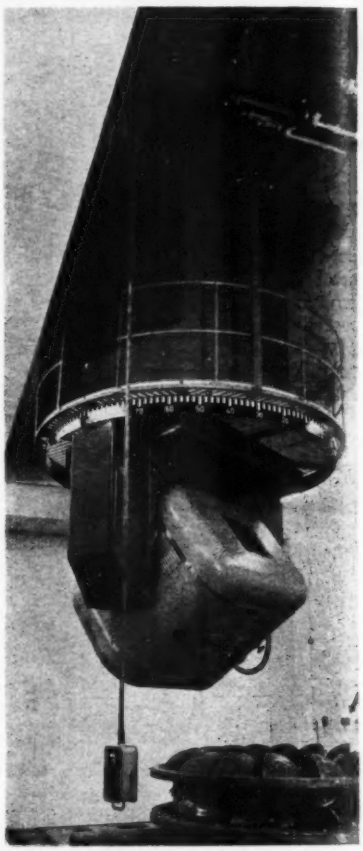
Local authorities can now record gamma radiation fall-out as they do temperature, barometric pressure, rainfall and hours of sunshine.

CPE 1457

Non-destructive testing

An instrument suitable for the non-destructive testing of very thick materials, and for research with high-energy *x*-rays and electrons, made by Brown Boveri & Co., is offered by Watson & Sons (Electro-Medical) Ltd.

The betatron's radiation energy is adjustable up to 31 MEV and in some models up to 35 MEV. Steel can be radiographed up to a thickness of 20 in. At full output and focus to film distance of 2 m., radiographs of 8 in. of steel can be obtained in 4 min. with a density of 2, and in 30 min. with 12 in. of steel. The instrument has two focal spots, each 0.1 × 0.3 mm. The wire penetrameter sensitivity over a thickness range of 6 to 14 in. of steel is almost constant at 0.3%. At 10 in. steel a 0.03-in.-diam. wire can still be seen. The very small focus size allows *x*-ray magnification to be used, and thus further improvement in sensitivity can be obtained.



Industrial 31 MEV betatron installation.

This apparatus can also be used for nuclear physics studies, including photo-nuclear reactions and generation of Cerenkov radiation. **CPE 1458**

Feed-meter

A new electrically operated *Feedometer* which is said to retain the accuracy of the previous models and at the same time reduce the initial cost of installation, is offered by Adequate Weighers Ltd. The meters are suitable for continuous process feeding or battery operation to blend together continuously any number of materials.

The electrical control relay equipment is in one cabinet with the main starting contractor for the motor drives. In the standard unit, the visible indicating signals, start and stop push-buttons, and isolating switch are mounted on the front hinged cover.

Sensing of the weighing system is accomplished by circuits of electronic relays which, when energised, operate additional relays which in turn feed two adjustable timing units and provide electrical interlocks in addition to those mechanically operated.

The timing units operate the reversing contactor for the feed control motor, which is driven intermittently until the weight error is satisfied by a suitable correction to the material feed. The intermittent drive thus prevents continual hunting of the weighing system.

Additional switches and relays are provided to stop the feeder in the event of feed failure or flooding, and also if the auto-feed control expires in either direction. Visible signals are given and contacts are provided for audible alarms.

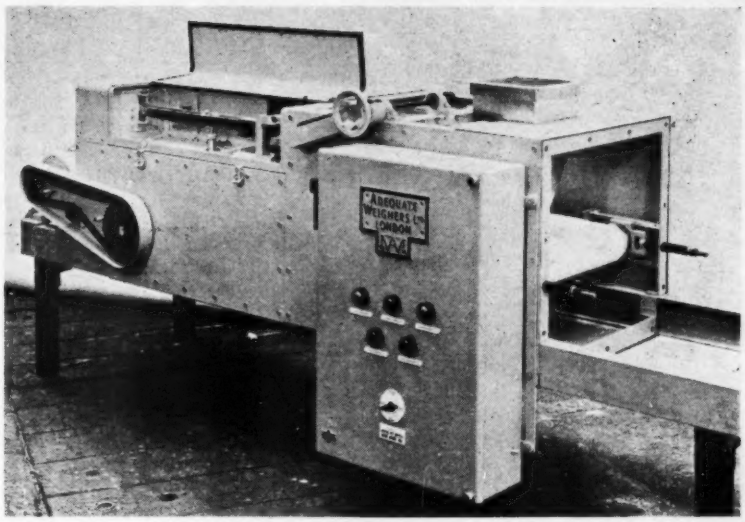
Various sizes of feeders are available, giving a range of up to 1,250 cu.ft./hr. of material, the throughput depending on the bulk density of the particular material to be fed.

The accuracy varies according to the output and nature of the material being handled, but an average working figure is in the order of $\pm 1\%$ over a 2-min. period. **CPE 1459**

Acetylene generators

Aut-O-Cet generators, used industrially for the supply of acetylene gas, are now available in two types, identical in operation but different in hopper design. The generator has a solid metal hopper with ' sight glass ' apertures for checking carbide level. The new alternative, the *Sight Feed*, has a reinforced *Pyrex* glass hopper which enables quicker checks on carbide level to be made.

Both models are claimed to produce pure cool acetylene at half the cost of cylinder gas. Manufacturers are Weldcraft Ltd. **CPE 1460**



Electrically-operated feeding machine for continuous feeding or blending of materials.

Enamelling

In conjunction with Ferro Enamels Ltd., Alfred Bullows & Sons Ltd. have produced equipment for applying vitreous enamels at very low pressures.

The technique is claimed to have several major advantages for the enameller, apart from the economy in enamel used. With a low-pressure nozzle it is a simple matter to obtain a fine coat which when fired is less brittle than a thick coat would be. Less skill is required than normal production methods.

Nozzles have been developed for this purpose on the L1900 *Bullows-Binks* model 19 and the L200 model 2 spray guns. **CPE 1472**

U.S. screen for Britain

Vibrating screens produced in the U.S., *Overstrom* screens, are to be manufactured in Britain under licence by Armstrong Whitworth (Metal Industries) Ltd. The firm has the rights for manufacture and sales throughout the world, with the exception of the Americas and New Zealand.

The screens are built for wet or dry, light, medium and heavy service. There are seven sizes ranging from 3 ft. $\times$ 18 in. to 16 ft. $\times$ 6 ft. and each can be equipped with one, two or three decks. All screens can be fitted with partial or complete dust-proof enclosures, water spray equipment, and heating units which are sometimes required for the finer mesh decks dealing with damp, sticky materials. **CPE 1473**

Measuring in 3-D

An instrument which measures not only the roundness circumferentially, but with the same stylus also measures straightness and parallelism (vertically), and by so doing provides a full three-dimensional description of the error of form of cylindrical components, is offered by Rubert & Co. Ltd. The makers are Hommel of Germany.

Another innovation is the automatic centring device which is claimed to take a fraction of the time taken by conventional methods.

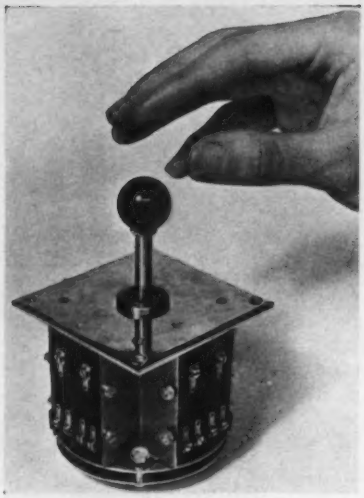
The instrument measures up to a maximal diam. of 6 in., and vertical height of 8 in., with a maximal magnification of error of form $\times 10{,}000$.

The equipment consists of four parts: the mechanical testing apparatus, the graph recorder, the control equipment and the viewing equipment. **CPE 1461**

Joystick control switches

A range of new joystick control switches which are claimed to be safer and more easily operated than conventional push-button systems has been developed by Pye Ltd.

With manual or automatic return from two to eight positions the controller has many basic variations. The joystick has all the advantages of visual directional movement, plus the inclusion of an isolator for additional safety. This advance in sequence control technique is stated to allow a wide range of applications—all of which require less space and are less expen-



Joystick control switch.

sive than an equivalent number of push-button units.

Basically the controller consists of a varied number of switches mounted under a 3½-in.-square chromium top plate. The switches are grouped evenly each side of the square and are operated by a control lever which passes through an oil-filled spherical bearing.

The operator moves the lever in the direction in which a traverse or operation should take place—a movement similar to changing gear in a car. This method of control is said to minimise the danger of careless operation resulting from the wrong selection of a push-button switch or similar component. Directions in which the lever can be moved are controlled by a gate plate mounted below the switches. Return to centre 'off' can either be spring-controlled, manual or a combination of both.

Controllers are available with stepped switching for multi-speed control and latest types include built-in potentiometers for infinitely variable control. Pye has also produced controllers with combined rotary and directional movement, which means that the lever can be returned directly to the 'off' or any other position without energising any of the intermediate circuits. Additional isolator switches can be provided to suit individual requirements. **CPE 1462**

Liquid gauge

A new pressure-bulb-type hydrostatic tank contents gauge, manufactured by Firth Cleveland Instruments Ltd., is claimed to measure the head of liquid in most types of non-pressurised tank, wherever situated and regardless of size and height. Its indicator can be placed up to 250 ft. from the tank to show by a dial and pointer, 4, 6, 8 or 12-in. diam., either the depth of liquid or the tank contents. The gauge is self-operative and offers continuous indication.

It is supplied as two units, transmitter and indicator, together with suitable airline and connectors. The tank liquid fills the lower chamber of the transmitter unit to apply a pressure against the lower surface area of a synthetic rubber pressure bulb. This pressure, the hydrostatic head of liquid in the tank, is transmitted through a small-bore copper or nylon airline to the indicator. It is necessary to know the density of the fluid in order to calibrate the indicator in depth units and also the tank size and shape if readings are required in volume or mass units. By reducing stiffness in the pressure bulb as much as possible, errors due to change in atmospheric pressure or in the temperature of the air in the sealed system have been reduced to negligible proportions. The bulb is made of variable thickness and of such a shape that in operation it is similar to a rigid piston of large area sealed by a membrane of low stiffness around its edge.

The gauge is said to be suitable for all liquids compatible with the materials of the bulb and its housing. This is normally of high-grade cast iron, which may be stove-enamelled, hot-tinned or left in natural finish depending on the liquid being gauged. **CPE 1463**

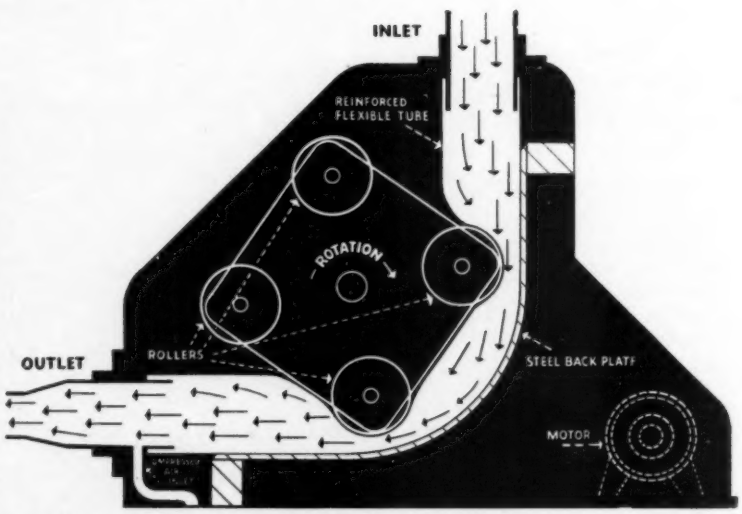
Powder pump

A new solids pump, designed for the short-transfer conveying of powders, is offered by Henry Simon Ltd. The *Squeegee* solids pump will convey practically any type of powdered material, providing it can be fluidised by air. Conveying rates, depending on the material handled, range up to 8,000 lb./hr. Vertical lifts up to 70 ft. with total conveying lengths of 200 ft. are being achieved under normal working conditions.

The pump consists of an open flexible tube, a rotor with four equidistant rollers, and a compressed air inlet. The action of the rotor progressively squeezes the material through the flexible tube, compressing and releasing the tube in turn, thrusting the material through in a continuous stream. Only then is air brought into contact with the stock. The air, unable to leak back through the pump because of the pressure of the rollers, is used solely for conveying the stock. The makers say only 10% of the air used in a conventional system is needed—for normal installations about 15 to 20 cu.ft./min. is adequate—and that no dust collection apparatus is necessary, a simple filter sock being sufficient.

Another feature of the pump is that in the event of the stock running out the pump can run dry without sustaining any damage.

The flexible tube is a consumable spare and can be replaced in minutes. Its working life is about 1,000 hr. **CPE 1464**



The diagram shows the features of the 'Squeegee' solids pump which is designed for short transfer conveying of powders.

★ American Developments in Brief ★

Small brass pumps designed to operate while fully or partially submerged in a variety of liquids have been introduced by Thomas Beckett & Co. Inc. The fractional-horsepower electric pumps are being used for pumping coolants on stone- and metal-cutting saws, and in the water-circulating system for ice-making machines. Made in three models with capacities ranging from 200 to 514 gal./hr., they are completely sealed in oil and come equipped with moulded neoprene cord sets, leakproof terminal blocks, high-torque low-temperature motors, a spring-loaded neoprene oil seal and a stainless-steel shaft. **CPE 1465**

★ ★ ★

What is believed to be the largest portable self-contained sand and dust test chamber was recently completed by the American Research Corporation. Designed for the testing of explosive and other hazardous components in remote areas, it has a test space 8 ft. wide × 5 ft. high × 4 ft. deep. It is equipped with automatic temperature control as well as temperature, humidity, air velocity and dust density indicators. **CPE 1466**

★ ★ ★

Among the claims made for *Hetron*(R)72 polyester resin, a chlorinated polyester, by the makers, the Durez plastics division of Hooker Chemical Corporation, is a good resistance to glacial acetic acid at 30 to 35°C. The resin is said to have advantages in both temperature and chemical resistance when fabricated into such laminated products as storage tanks, piping, scrubbers, columns, ductwork and similar processing or plant equipment. **CPE 1467**

★ ★ ★

Two new types of holdbacks are offered by Stephens-Adamson Mfg. Co. The standard roller type is a simple unit designed to give protection to bucket elevators and inclined conveyors. The totally enclosed type features a cast-steel housing, hardened wedge block and hardened steel rollers, and is intended for protecting inclined conveyors and bucket elevators against accidental reversal. **CPE 1468**

★ ★ ★

A new flocculating agent in granular form, *Superfloc* 16, is offered by Cyanamid International. It is said to be particularly effective in thickening operations for increasing settling rates and overflow clarity. A high bulk density product, its essentially dust-free granular form makes it easy to feed, wet and dissolve. In addition to uranium mining the company expects it to find wide applications in the clarification of coal plant effluents, treatment of water and suspensions of sewage, industrial wastes and chemical precipitates. **CPE 1469**

★ ★ ★

Large plastic scintillation fluors are now being polarised and produced by the single crystal division of Simi-Elements Inc. The fluors weigh about 400 lb., before machined, and it is possible to get 16 in. in diam. and 24 in. in length from them. Due to the size the castings are being sold in the rough. **CPE 1470**

★ ★ ★

Six new radiochemical compounds are available from Tracerlab's radiochemical department. All are organic and labelled with carbon-14. The new compounds are: acetone 1, 3-C^{14}, a ketone used in industrial organic research; bromacetic acid 1- and 2-C^{14} and malonic acid 1, 3-C^{14}, intermediates in the synthesis of amino acids; propylene 1-C^{14}, the monomer of the plastic polypropylene and used in determining its chemical reactions and metabolic rate; and tristearin carboxyl-C^{14}, used in biological research for the study of the metabolism of fats. **CPE 1471**

INDUSTRIAL PUBLICATIONS

Gas treatment. A summary of the unit operations performed by the plant of Whessoe Ltd. in the gas treatment and gas and liquid storage field, and the combination of these units into integrated systems is contained in an illustrated pamphlet. Mention is made of electro-detarrers, multi-stage scrubbers, disintegrators, purifiers, vapour recovery and other plants.

Platinum catalysts and many of their uses in the processing industries are dealt with in a pamphlet from the Baker platinum division of Engelhard Industries Ltd.

Boiler mountings and valves. This catalogue, covering the complete range of Hopkinsons Ltd.'s boiler mountings and valves up to steam pressures of 250 p.s.i., is designed to meet the requirements of a large number of industrial installations.

First come the firm's recommendations for mountings and valves for *Shell*-type boilers, including the size and type of valve suitable for any given service. Then come pages devoted to iron, steel and bronze stop valves. The final sections are steam traps and reducing valves.

Speciality resins. A booklet dealing with *Araldite* speciality resins has been produced by Ciba (A.R.L.) Ltd., Duxford, Cambridge. The resins are used for surface coatings, potting and lamination resins, casting, adhesives and fillers. Five resins, and their uses at a variety of temperatures, are described.

Export. A booklet has been published with the object of assisting firms without previous experience in overseas trading in the commencement and development of an export business. It is intended as a general guide and can be obtained from the Gauge and Tool Makers' Association.

Pilot plant and small-scale equipment for chemical engineering research, teaching and process development are described briefly in a leaflet, SSE159, available from Apex Construction Ltd. Drying, distillation and evaporation, mixing, separation and classification and heat-transfer equipment are included. A leaflet on pharmaceutical laboratory equipment is also available.

Surface heaters. Isopad Ltd. have issued a new edition of their PLT catalogue, describing industrial electrical surface heaters. This gives several new illustrations of *Isojackets* used on vacuum chambers, of special *Isomantles* for pumps and some new types of drum heaters. It also contains a complete specification of *Isotapes* for pipe tracing, and full particulars of thermostatic controls.

Air heaters. A leaflet (L. 3) from Peabody Ltd. describes oil, gas and coal burners, a direct-fired air heater for process work on many special applications requiring clean, hot air or inert gas, control panels which are specially designed to individual requirement of each installation, and gas scrubbers, absorbers and coolers.

New Books

Process dynamics

Emphasising a general approach to process dynamics this book* examines the characteristics of processes under unsteady-state conditions or in response to periodic disturbances. The author, who died in January 1957, views process design and control design as an integrated problem in process systems, and the use of linear network theory as a means of predicting the dynamic performance of a plant before it is built.

The material came from the author's work as a consulting engineer and from the research he conducted in feedback control theory and process during ten years at Massachusetts Institute of Technology. He was dissatisfied with the approach used to design industrial processes and to apply automatic controls to them because 'it is not quantitative and it is not founded upon a sound theoretical basis.' He stated that, in process control, knowledge of process behaviour comes first and the dynamic response of most processes can be defined quantitatively and thus the purpose of the book is to explain process physics and to translate these basic definitions into mathematical form so that their influence upon process control system design can be shown.

It is written for both the engineering student and the practising engineer, but the reader must have some knowledge of both ordinary and partial differential equations and the Laplace transformation, and be familiar with automatic feedback control.

**Process Dynamics*, by D. P. Campbell. John Wiley, New York, and Chapman & Hall, London, 1958. Pp. 316, illus., 84s. net.

Building at Windscale

This book* is the outcome of a number of papers on civil engineering problems encountered during the construction and maintenance of Windscale works, the first British factory to produce fissile material on a large scale. It is addressed mainly to civil engineers and construction personnel but may be useful to those engaged on the expanding programme of nuclear power station construction. The book ranges over a wide field, indicates some of the problems which arose and were dealt with, and gives an appreciation of the planning and organisation required to concentrate enough men, materials and equipment on to a site in order successfully to meet a very tight and stringent programme.

**Windscale*, by S. Sinclair. Newnes, London, 1960. Pp. 136, illus. 25s. net.

Hot-dip galvanising

This book* consists of the edited proceedings of the international conference on hot-dip galvanising held in Holland and Belgium in June 1958. Twenty papers from eight countries were presented. They have been printed as ten chapters and each chapter concludes with an edited account of the discussion which followed. In several cases important written contributions received since the conference have been included to bring the book completely up to date. Brief notes on each of the chapters are attached.

Many aspects of interest to both specialists and general galvanisers are described, and users of galvanised products will find the chapters in painting and thickness testing of interest.

**Fifth International Conference on Hot Dip Galvanizing, June* 1958. Zinc Development Association, London, 1959. Pp. 355, 60s. net.

Thermodynamics

The primary object of this book* is to acquaint the student meeting thermodynamics for the first time with the basic ideas upon which the applications of thermodynamics to chemistry are founded.

The first seven chapters form an elementary survey of some of the simplest applications of thermodynamics and provide the basis of a short introductory course suitable for students studying, for example, chemistry to pass degree level, or subsidiary to biological subjects. Only a minimum of mathematical knowledge is presumed and for the most part nothing more than simple algebra and geometry is employed.

More advanced chapters follow on non-ideal solutions, on electrochemical systems, on the use of graphical representations of chemical equilibria, and on methods of determining free energies. The chapter dealing with the laws of thermodynamics is intended to prepare the student for a study of more advanced textbooks, and attempts to set in perspective some of the alternative approaches to the enunciation of the fundamental laws. A final chapter is concerned with methods of determining free energies.

**An Introduction to the Study of Chemical Thermodynamics*, by D. H. Everett. Longmans, London, 1959. 28s. net.

Industrial alcohols

Alcohol solvents enter into every kind of industrial activity and this handy reference* provides a convenient source of information for many industries.

The third in a series, this volume presents the physical properties, azeotropic mixtures and uses of industrial alcohols. The nomenclature includes commercial names where applicable. A historical survey describes the early production by malting and brewing and leads up to present-day synthesis —Fischer-Tropsch, isosynthesis, oxo process and the oxyl process. Methods of manufacture and newer methods of fermentation are also discussed.

**Source Book of Industrial Solvents*, Vol. 3: 'Monohydric Alcohols,' by Ibert Mellan. Reinhold and Chapman & Hall, London. Pp. 276, 80s. net.

Process integration

There have appeared recently a number of books on instrumentation, control and automation, but few of these have dealt with the necessary units of equipment which together allow various degrees of automatic working to be achieved. Designed to fill the gap, this book* has been written with the requirements of the industrial manager and production executive of the medium and small concern in mind.

The steps which lead from detection and measurement to indication, recording and eventually to automatic control are intricate and impinge on a wide range of specialised skills. Chemistry, physics, electrical, mechanical, electronic and nuclear engineering are involved, all of which have their peculiar and rapidly extending vocabularies. The book outlines in simple form the means by which the variables occurring in manufacturing can be sensed, measured and controlled with the ultimate object of achieving a more complete and integrated process.

**Process Integration and Instrumentation.* The Electricity Development Association, 1959, London. Pp. 204, illus., 8s. 6d. net.

Company News

A sulphur-burning contact sulphuric acid plant has recently been completed by Chemical Construction (G.B.) Ltd. at the Billingham works of British Titan Products Co. Ltd. This addition to the sulphuric acid plants of British Titan is one of the two largest in Britain and is the fifth supplied to them by Chemical Construction.

The plant has a design capacity of 250 tons/day using sulphur as raw material and to produce sulphuric acid at 98% concentration.

Sulphur is melted in steam-heated melting tanks and is pumped into the sulphur furnace *via* two *Chemico* spray burners each handling around 45 tons/day. The contact section uses a *La-Mont* waste-heat boiler for cooling the SO_2 gas and raising steam. The plant is equipped with a *Chemico* hot gas filter of new design placed after the boiler and economiser. The filter is designed to enable a rapid change of the filter medium without an extended shut-down. It is estimated that a complete change-over may be made in less than 4 hr., while the plant is still hot.

This plant brings British Titan's sulphuric acid capacity at both Grimsby and Billingham to over 1,000 tons/day.

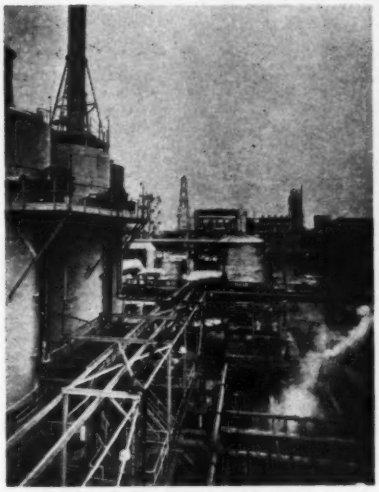
*

Transport of tonnage oxygen plants in a near-assembled state has been effected for the first time. Two plants, each of which will produce 100 tons/day of oxygen, were moved by road from the Edmonton works of British Oxygen Engineering Ltd. to the Scottish Gas Board's site at Westfield in Fifeshire, where they will play an essential part in the production of town gas by the *Lurgi* process. The plants are the first of a new type.

Transport of the two plants in a virtually assembled state saved many manhours in erection time compared with conventional plants, which are erected wholly on site. To achieve this saving, however, major transport problems had to be solved. The project involved manoeuvring such parts as two 24-ton air separation units—which are 35 ft. long and 12 ft. diam.

*

A new phase of propylene utilisation is now in full swing in I.C.I.'s Teesside petroleum chemicals enterprise. Propylene oxide and propylene glycol are now in commercial production, and the commissioning of the new



Sulphur-burning contact sulphuric acid plant at Billingham.

Propathene plant in late 1960 will add a third new use for propylene.

These developments have been made possible by the recent extension of propylene capacity at Wilton to over 80,000 tons p.a. I.C.I. has thus been able to implement plans not only for these new products, but also for making additional feedstock available for existing propylene derivatives, namely isopropyl alcohol, acetone, and normal and iso-butanols.

Propylene oxide and propylene glycol are expected to be supplied to industry at large, as well as within I.C.I.

*

A new £500,000 office block is being erected at Richborough, for Pfizer Ltd.

Over 450 tons of structural steel has been used for the five-storey, 80-ft.-high building which will be completed later this year.

*

The Elliott-Automation group has widened the scope of its interests in control valves by the purchase for cash of Black Automatic Controls Ltd., of Corsham, Wilts., manufacturers of a wide range of control valve and pressure regulating equipment.

Elliott-Automation, which owns 25 companies operating in the field of automation, has now, including Black Automatic Controls, four companies producing control valves of various kinds.

With the acquisition of Black Automatic Controls the group's valve interests in the gas and chemical industries are again being expanded. It is thus a further example of the policy of the group of continuously expanding its interests in the field of automation.

*

Metal Propellers Ltd., who design and fabricate plant in stainless steel and similar alloys, have acquired the Standard Steel Co. (1929) Ltd., who occupy adjoining premises in Croydon.

The Standard Steel Co. are steel stockists and constructional and mechanical engineers who undertake the supply and erection of structural steelwork of all types. Steelwork for the new Croydon Technical College is one contract recently completed.

Mr. C. Colley, managing director of Metal Propellers, has been appointed managing director of Standard Steel. Mr. D. R. Morgan, who will continue as a director of Standard Steel, has been appointed general manager of that company, and a director of Metal Propellers.

*

To serve the growing tyre and rubber industry in the Common Market area and in the Outer Seven, the Columbian Carbon Co. and the Continental Carbon Co. have made arrangements to co-ordinate manufacturing facilities of their two major plants in the European area.

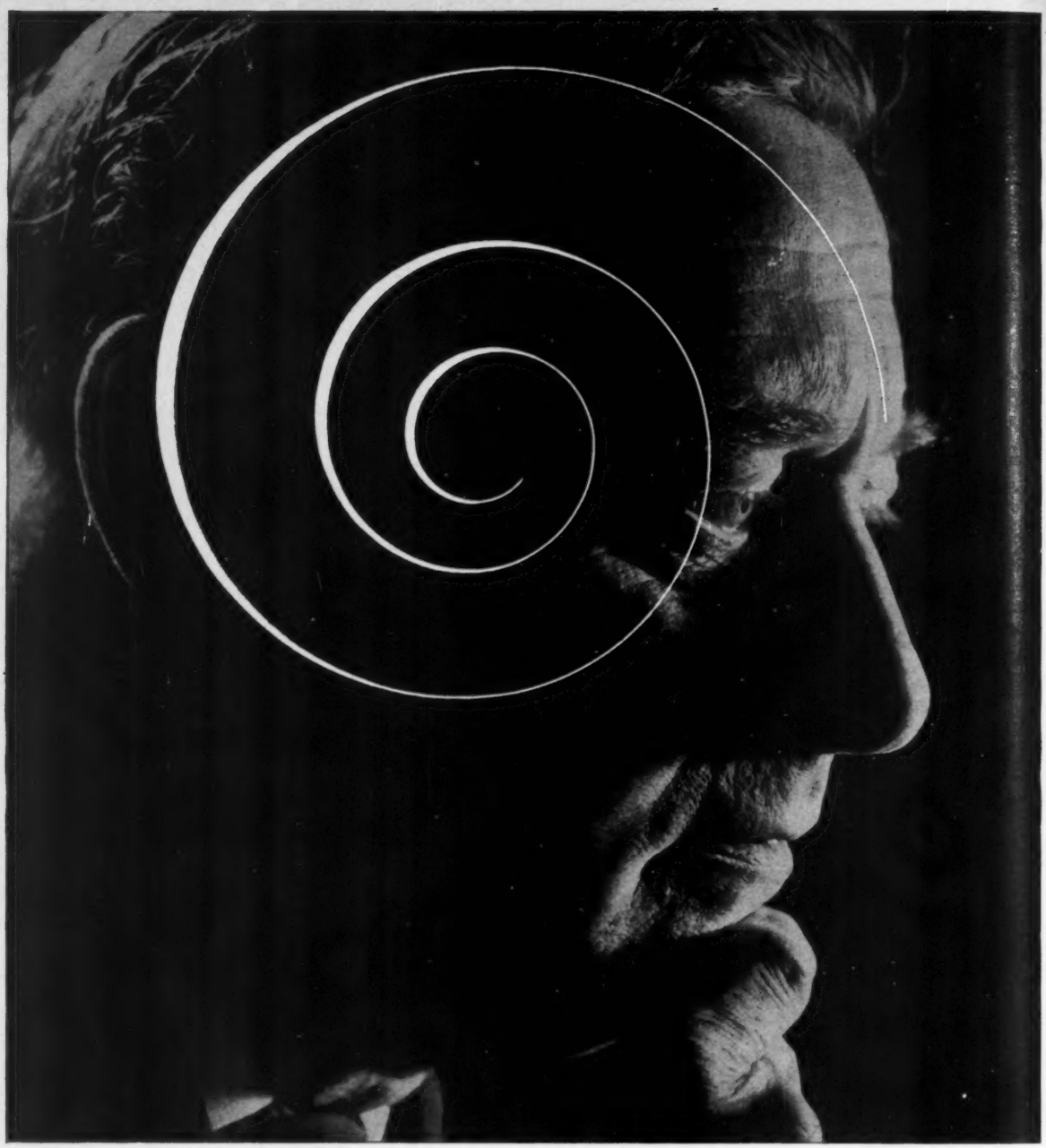
The Columbian Carbon Co. has purchased an interest in Continental's new £25-million carbon-black plant in Rotterdam, which will be operated as 'Continental-Columbian Carbon (Nederland) N.V.' This plant will be in production in mid-spring of this year.

Continental Carbon Co. has purchased an interest in the new £60-million carbon-black plant being built by Columbian Carbon Co. near Milan. This will be operated as 'Columbian Continental Europa SpA.,' and will be completed in the late autumn of 1960.

*

Kaiser Aluminium & Chemical Corporation and Delta Metal Co. Ltd. have organised a new aluminium fabricating company in the U.K. which will be known as James Booth Aluminium Ltd., and succeeds James Booth & Co. Ltd., a Delta Metal subsidiary.

Kaiser Aluminium will invest $14 million, half of the initial capital of the new company. All of these funds will be used to expand Booth's Kitts Green works at Birmingham, extending the range of its wrought aluminium products.



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The interests of the Royal/Dutch Shell group of companies, Continental Oil Co. and the Union Stockyards of Houston and Transit Co. of Chicago, in the liquefied natural gas field are to be developed through the medium of a jointly owned company to be known as Conch International Methane Ltd.

The formation of the new company is expected to accelerate the development of commercial transportation of methane in liquid form from producing countries to distant markets in the industrial areas of the world.

★

Richardsons Westgarth & Co. Ltd. have formed a subsidiary company, Richardsons Westgarth Inc., with offices in Washington, D.C. The new company will act as selling agent in the U.S. for products made by the company in Britain and will also be able to act as main contractor where plant is made in the U.S.A. to Richardsons Westgarth designs.

★

A merger has been arranged between Durapipe & Fittings Ltd., manufacturers of thermoplastic rigid pipe and fittings, and the plastic division of H. Incledon & Co. Ltd. The activities of the latter have covered design, fabrication and erection as well as the supply of standard *Durapipe* and fittings. Both companies are in the Incledon and Lamberts Ltd. group, and this integration of their plastic activities has been arranged with the object of increasing efficiency and improving the service to their many customers.

★

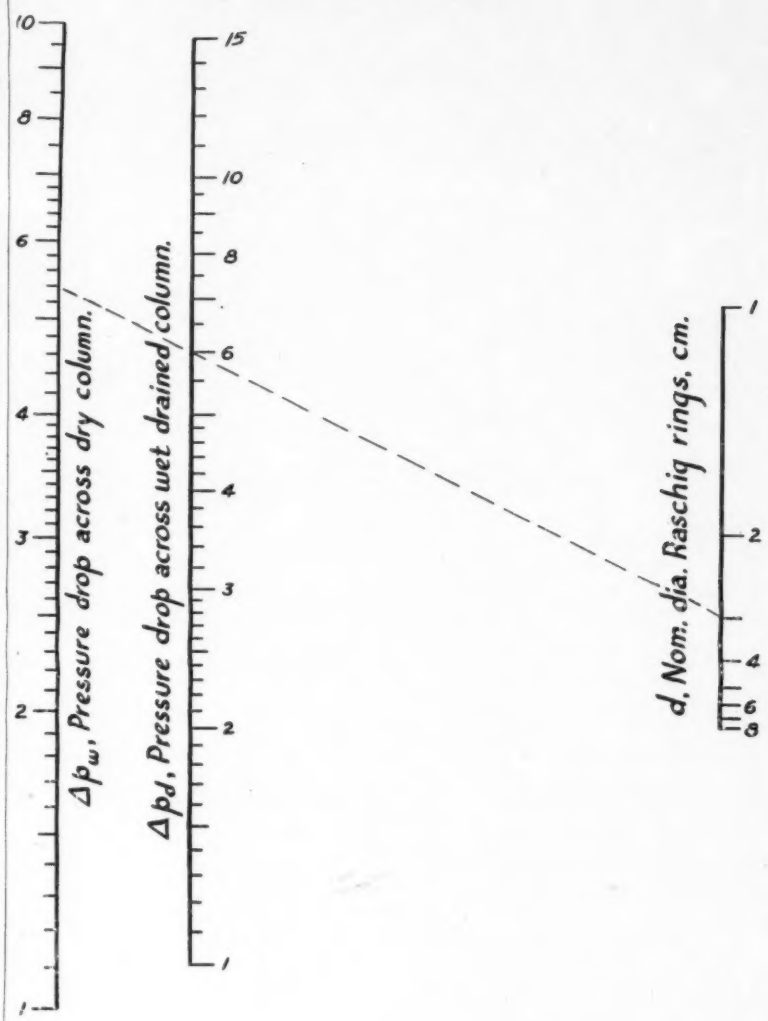
The price of *Petro-Chem* furnaces has been reduced by Birwelco Ltd. This is due to the more competitive price of commodities used in the industry together with factors such as the threat of fiercer competition from the Common Market countries.

Nuclear energy information day

An International Day of Information on nuclear energy is being organised for the International Fair in Liége, Belgium, on June 9. The day, organised by 'l'Association des Ingénieurs sortis de l'Institut Montefiore,' will consist of a series of lectures on developments in nuclear energy in recent years. Details from P. Fourmarier, Le Président du Comité Scientifique, Association des Ingénieurs, 31 Rue Saint-Gilles, Liége, Belgium.

Pressure Drops Across Wet Drained Columns

By Prof. D. S. Davis*



Pressure drops across wet drained columns packed with Raschig rings can be calculated through use of the equation:[1]

$$\Delta p_w = \Delta p_d \, (1 + 0.33/d)$$

where Δp_w and Δp_d are the pressure drops across the wet drained and dry columns, respectively, when the nominal size of the Raschig rings is d cm.

The nomogram, which was constructed in accordance with methods described previously,[2] enables rapid and accurate solution of the equation. The broken line shows that, when the pressure drop across a dry column packed with 3-cm. Raschig rings is 5.4 units, the pressure drop across the wet drained column is 6.0 units.

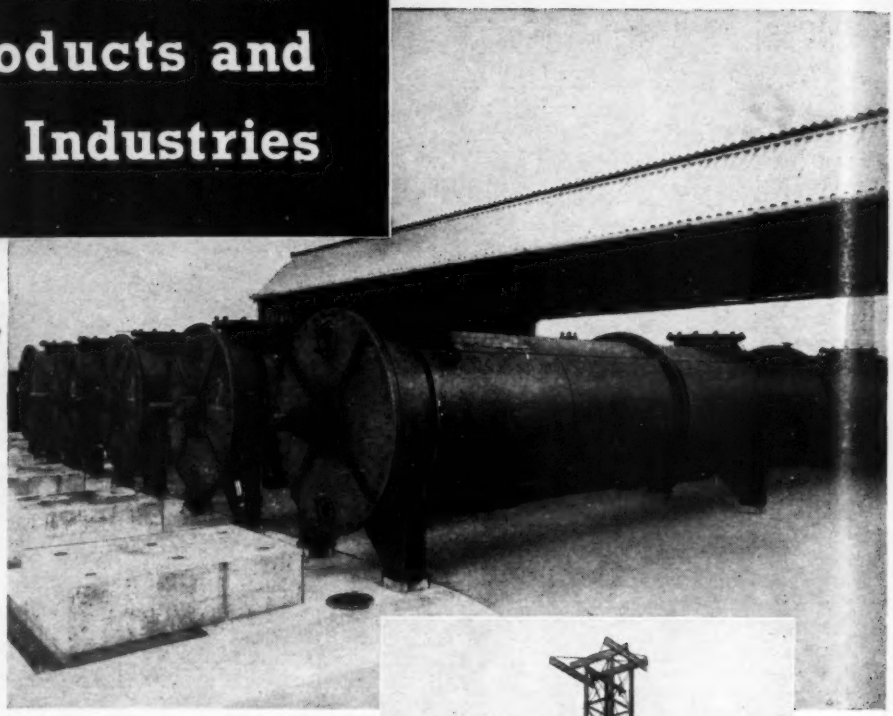
Any units for the pressure drops can be used as long as they are the same.

REFERENCES

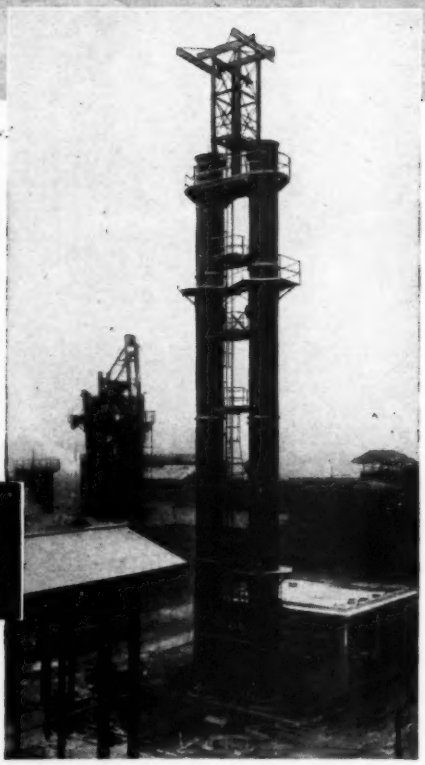
[1]J. M. Coulson and J. F. Richardson, 'Chemical Engineering,' Vol. II, p. 410. McGraw-Hill, 1955.
[2]D. S. Davis, 'Nomography and Empirical Equations,' Chap. 6. Reinhold, New York, 1955.

*University of Alabama

Engineers to the Chemical, Oil, By-Products and Allied Industries



Battery of 10—Naphthalene Crystallisers. Shells jacketed. Each unit 30′ 0″ long. Location flat concrete roof at 80′ 0″ level. Illustration by courtesy of Yorkshire Tar Distillers Ltd., Cleckheaton, Yorkshire.



Two—Oil Distillation Columns, 99′ 8½″ overall height. After manufacture of the component parts in our Shops, complete site erection was undertaken by our Staff at Cadishead, Lancashire. The Columns were designed by Proabd (England) Ltd., for Lancashire Tar Distillers Ltd., and by whose joint permission, and courtesy, we are able to publish this illustration.

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Technology Notebook

Powder metallurgy

The powder metallurgy joint group of the Iron and Steel Institute and the Institute of Metals will hold an informal discussion on 'Direct Rolling Processes in Powder Metallurgy' in the Hoare Memorial Hall, Church House, Great Smith Street, London, S.W.1, on April 12. Information from the joint group, 17 Belgrave Square, London, S.W.1.

Plastics

The number of applications for stands at the International Plastics Exhibition 'macroPlastic 1960' at Utrecht have made it necessary to reserve two halls in addition to the three planned at first. Preceding the exhibition, to be held from October 19 to 26, there will be an international plastics congress at which some 40 speakers of several nationalities will deal with the various problems of the technology of plastic processing. Details from macroPlastic, Internationale Kunststoffinbeurs, Tesselschadestraat 5, Amsterdam, Holland.

Industrial training

The education group and Midland branch of the Institute of Physics will be holding a joint conference on 'The Training of the Industrial Physicist' on April 21 and 22 in Birmingham. Papers will be presented on the following subjects and time will be allowed for discussion: Problems of selection for diploma in technology and university degree; the university degree and diploma in technology compared as a training for the industrial physicist; postgraduate training in physics; and requirements of industry.

Programmes and registration forms available from the Secretary of the Institute, 47 Belgrave Square, London, S.W.1.

Non-destructive testing

The non-destructive testing group of the Institute of Physics will hold a meeting in London, on May 2 to 4, jointly with the Société Francaise de Metallurgie. The programme will have the general theme of the relationship between structure and physical properties of materials and will include recent advances in non-destructive testing techniques. Further details available from the Secretary, the Institute of Physics, 47 Belgrave Square, London, S.W.1.

Hot laboratory and equipment conference

The hot laboratory division of the American Nuclear Society announced that summaries of papers to be submitted for the eighth Hot Laboratory and Equipment Conference to be held in San Francisco, December 11 to 14, are due before May 16. This meeting will be held simultaneously with the Society's winter meeting, and in conjunction with the nuclear industry exhibit and meeting of the Atomic Industrial Forum. Information from programme chairman: J. R. Lilienthal, Los Alamos Scientific Laboratory, P.O.B. 1663, Los Alamos, New Mexico, for information regarding the form in which the summaries are to be prepared. Accepted papers will be due September 1.

Papers are invited on all phases of hot laboratories and equipment for handling radioactive material; such as design and construction of facilities and equipment, dry boxes, manipulators, shielding, operations, costs, etc.

Power

The World Power Conference sectional meeting will take place in Madrid from June 5 to 9. The general theme for the meeting, 'Methods for Solving Power Shortage Problems,' has been chosen in view of the desire to increase the traditional sources of power, or replace them by other sources. Technical sessions will be held simultaneously in two rooms, where discussions on the different sections into which the main subject has been divided will take place. There will also be visits to plants in and near Madrid alternating with cultural or tourist excursions. A full programme is available from the Secretary, British National Committee, World Power Conference, 201-202 Grand Buildings, Trafalgar Square, London, W.C.2.

Radiation

A summer school on health physics (radiation protection), arranged by H. D. Evans, lecturer in radiation hazards and health physicist, will be held in the nuclear technology laboratories of the department of chemical engineering and chemical technology, Imperial College.

The two-week course, starting July 4, should be of interest to university radiation protection officers concerned with radiation and radioactive hazards, medical officers of health, factory inspectors and others concerned with radiation protection.

A university degree in science or medicine will be regarded as the minimum entrance qualification, but other suitably qualified persons will be considered.

Applications for admission to the Registrar, Imperial College, South Kensington, London, S.W.7.

Radioisotopes

A major scientific conference to be arranged by the International Atomic Energy Agency in 1960 will be held in Copenhagen, September 6 to 17.

It will deal with the use of radioisotopes in the physical sciences and industry and it is expected that more than 500 scientists from the agency's 70 member states will attend.

The results of recent research work will be submitted and discussed and the rapid progress that has taken place recently in this field will thus be made available to all countries.

Powders in industry

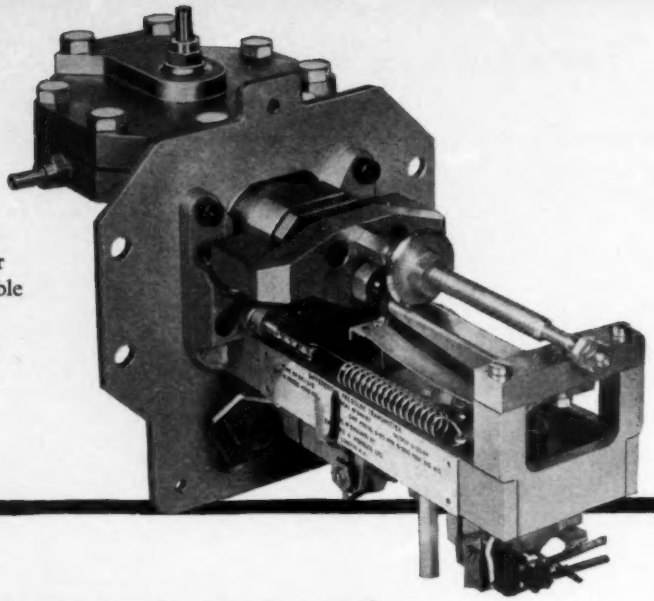
A symposium, under the chairmanship of Sir Eric Rideal, M.B.E., is to be held on the properties and principles of application of powders in industry. The symposium is organised by the surface-activity group of the Society of Chemical Industry for September 29 and 30 at the Royal Institution, 21 Albemarle Street, London. Information from the hon. secretary of the group, 14 Belgrave Square, London, S.W.1.

Fluid power

The second European Fluid Power Conference is to be held from April 25 to 29 at the Empire Hall, Olympia, at the same time as the International Compressed Air and Hydraulics Exhibition. The organisers, *Compressed Air and Hydraulics*, a monthly journal, say they are expecting 2,500 delegates at the conference and some 25,000 tickets have already gone to exhibitors alone. Information from the conference secretary, St. Richard's House, London, N.W.1.

Automation

The preparations for the second Interkama — International Congress and Exhibition for Instrumentation and Automation—to be held in Düsseldorf from October 19 to 26, have been completed. The Interkama 1960 will be twice as large as its predecessor held in 1957. About 300 exhibitors will be represented on an exhibition hall area of some 30,000 sq. m.



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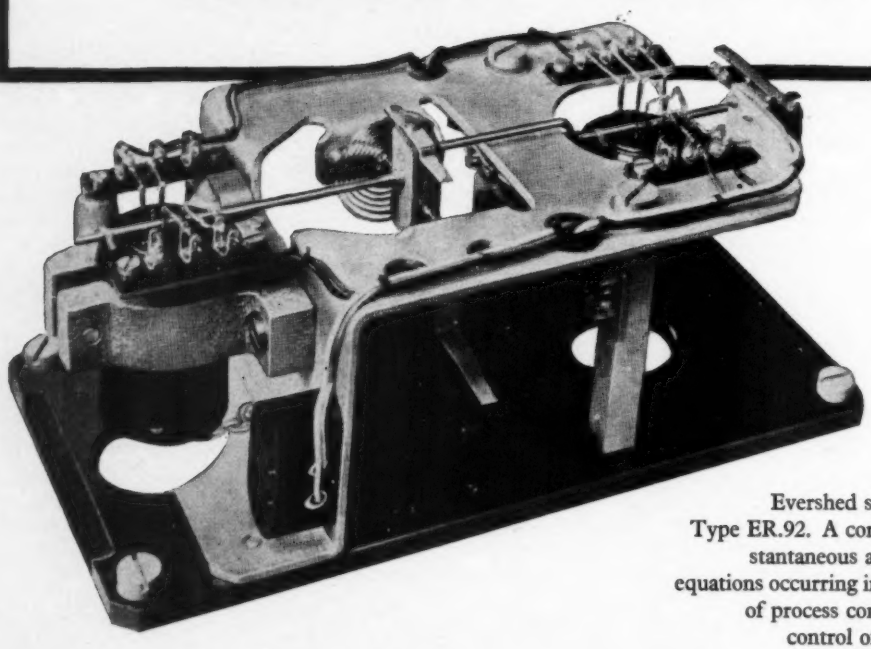

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Personal Paragraphs

★ The Messel Medal, the senior award of the Society of Chemical Industry, awarded every two years, will be presented to the medallist for 1960, the **Rt. Hon. The Viscount Chandos,** D.S.O., in Bristol on July 6 during the annual meeting of the society. The medal is awarded for meritorious distinction in science, literature, industry and public affairs.

★ **Sir Walter Worboys** has been elected to the board and appointed a deputy chairman of BTR Industries Ltd.

★ **Mr. J. Greatorex** has been appointed chief inspector of Sintered Products Ltd. He has been with the company since he completed his military service in 1953 in which time he has progressed from laboratory assistant to head of the inspection department.

★ **Mr. F. W. Tomlinson,** managing director of Pyrotenax Ltd., **Mr. J. M. Willey,** director and general manager of Murex Welding Processes Ltd., and **Mr. P. S. Bryant,** of Murex Ltd., have been appointed to the board of Murex Ltd. Mr. Tomlinson has also been appointed to the board of Murex Welding Processes Ltd., Waltham Cross.

★ **Mr. R. Miles,** chairman and managing director of Head Wrightson & Co. Ltd., retired at the end of the company's financial year, January 31. He has been chairman of the company for ten years, and managing director for 25 years. He remains on the board of the parent company. **Sir John Wrightson,** vice-chairman and managing director for the last ten years, has been appointed to succeed him as chairman and managing director.

★ **Dr. D. T. Lewis** has been appointed Government Chemist. He succeeds **Mr. E. H. Nurse,** C.B.E., who has been acting Government Chemist since the death of **Dr. G. M. Bennett** last year, and who retires on March 31. Dr. Lewis, who is 50, has for the last seven years been senior superintendent in charge of the chemistry division at the Atomic Weapons Research Establishment, Aldermaston.

★ **Mr. R. Jolly,** formerly in charge of the Manchester area office, has now been appointed manager of the enlarged field engineering division of Benson-Lehner (G.B.) Ltd.

★ **Mr. J. G. Ashworth** has been appointed buyer in charge of the purchasing department at the Stone factory of Quickfit & Quartz Ltd. He will be responsible for purchase of proprietary articles and for all subcontract work undertaken by the company.

★ **Mr. J. A. Goddard,** director and secretary of Fry's Diecastings Ltd., has been elected chairman of the Zinc Alloy Die Casters Association for 1960. He succeeds **Mr. K. J. Whitehead,** joint managing director of Wolverhampton Die Casting Co. Ltd.

★ **Mr. R. E. F. Sykes** has been appointed general manager of Griffin & George (Laboratory Construction) Ltd. He succeeds **Mr. A. E. Lambert,** who has retired from the company.

★ The British Iron and Steel Research Association announced that **Mr. S. S. Carlisle,** head of the physics department, has been appointed an assistant director. He will be especially concerned with the co-ordination of the Association's work on automation and information handling. His work will include co-operation with laboratories and firms outside the Association with a view to increasing the overall research and development effort devoted to automation in the steel industry.

★ **Mr. G. A. Siegelman,** formerly director, liquid fuels operations, has been appointed director of research and engineering for the energy division of Olin Mathieson Chemical Corporation. He will also continue to direct the division's operations in the Niagara Falls area. He joined the company in 1957 as an executive for operations and construction engineering.

★ Marchon Products Ltd., a member of the Albright & Wilson Group, announced the following appointments. **Mr. R. D. Cribb** has been appointed sales manager of Solway Chemicals Ltd. **Mr. B. Milling** has been appointed sales research officer. His main function will be the promotion of Marchon's existing surfactants and chemical auxiliaries towards their use in industries outside those already served.

★ **Brigadier H. P. Crosland,** C.B.E., chairman and managing director of Metal Traders Ltd., has been elected chairman of the Zinc Development Association for 1960. The former chairman, **Mr. R. T. de Poix,** O.B.E., will continue as a member of the council of the Association.

★ **Mr. R. D. Douglas** has been appointed assistant company secretary of Pfizer Ltd. and Universal Laboratories Ltd. Both companies are members of the Pfizer Group. A barrister-at-law, he has been head of the legal department of Pfizer Ltd. since 1957.

★ Resulting from the merging of the resources of Reynolds T.I. Aluminium Ltd. with British Aluminium Co. Ltd. the following appointments were announced. **Mr. G. Lacey** became executive director (forward planning), **Mr. G. A. Anderson** director of products and development, **Mr. B. James** director of sales, **Mr. J. Salter** director of engineering, **Mr. P. R. McGehee** director of production (manufactured products) and **Mr. W. B. C. Perrycoste** director of production (primary products).

★ **Mr. A. W. Evans,** formerly sales manager of Air Control Installations, has been appointed manager of Ambuco Ltd., a subsidiary of Buell Engineering Co. Inc. He will be spending two months in America at the parent company's offices studying their methods and current developments.

★ Babcock & Wilcox Ltd. announced the following changes in staff appointments. **Mr. A. S. Peacock** is appointed purchasing controller. He will have responsibility for all matters of company buying policy, operating from the London headquarters. He replaces **Mr. J. S. Greenhalgh,** who becomes manager, construction equipment division, with responsibility for control and co-ordination in the manufacture and marketing of new products for the building and contracting industries.

★ **Mr. F. K. McCune,** known for his work in atomic energy, has been appointed vice-president (engineering services) of the General Electric Co. in New York. He will be concerned with effective direction of the effort and use of the company's engineering resources. He will be a member of the company's executive office which is charged with providing long-range planning and guidance for the company as a whole.

★ **Mr. C. N. Freeston** has been appointed group projects engineer for the Frederick Braby Group of companies. **Mr. J. F. Nash** has been appointed chief engineer of Auto Diesels Ltd.

Orders and Contracts

Ashmore, Benson, Pease & Co. Ltd., a member of the Power-Gas group, have recently received orders from Petroleos Mexicanos, through Fluor Engineering & Construction Co., for fabricated refinery equipment of a value exceeding £0.25 million.

The equipment, which is for the Minatitlan refinery, near Vera Cruz, Mexico, includes over 70 heat exchangers and two large vessels.

The vessels are 12 ft. diam. and 214 ft. long. Due to transport considerations, each vessel will be despatched from the company's South works at Stockton in four sections, one vessel being finally shipped in sections, whilst the sections of the other will be welded on the dockside at Birkenhead prior to shipment in one piece.

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Port Talbot Chemical Co. Ltd., formed jointly by the Steel Co. of Wales Ltd., and Lincolnshire Chemical Co. Ltd., have placed contracts for the first hydrorefining plant in Britain to refine coke-oven crude benzole to pure benzene. The plant is designed to treat 4.5 million gal. p.a. of crude and provision has been made for doubling this capacity. It uses coke-oven gas as the source of hydrogen. The hydrorefining plant itself is being supplied by Lurgi of Germany, with Simon-Carves Ltd. responsible for erection, the procurement of English supply equipment, and the installation of electrical equipment and instrumentation.

The new plant will be within the Port Talbot works of the Steel Co. of Wales, whose coke ovens will supply the crude benzole and coke-oven gas.

It is expected to start up towards the end of the year and Cremer & Warner have been appointed consulting engineers for the project.

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Avo Ltd., a company in the Metal Industries group, has secured a contract from the U.K.A.E.A. to install the criticality incident detection system.

This system has been designed by the U.K.A.E.A. for the detection of radiation in the second plutonium processing plant now being installed at the Authority's Windscale establishment; Avo instruments were specified.

Under the system, it will be possible to determine and localise incidents in such a manner as to enable evacuation of the building to take place with the minimum risk to personnel. Warnings will be given audibly and visually. In addition, instrument readings will be available at a remote point to facilitate, in association with recording equipment, the determination of radiation patterns.

The buildings of the Windscale works where the fuel element laboratory is being installed.

★

William Boby & Co. Ltd. have been awarded contracts valued at £16,000 for dealkalisation/base exchange plants by George Wimpey & Co. Ltd. for the Union Carbide Ltd. works at Hythe.

★

An agreement has been reached between I.C.I. and the Czechoslovakian Silon National Corporation, whereby I.C.I. has granted to the corporation a non-exclusive licence under certain patents in Czechoslovakia for the manufacture of polyester fibre.

The rights granted do not cover the provision of technical information or any rights to use I.C.I.'s trade mark *Terylene*.

★

A contract for the design and provision of the most advanced irradiated fuel element cave laboratory, with a capital value of approaching £1 million, has been awarded to E. G. Irwin & Partners Ltd. by the U.K.A.E.A.

The facility is being installed in the blower houses of No. 2 reactor of the Windscale works which closed down as a safety measure after the incident in 1957. The laboratory is designed to handle several thousand fuel elements p.a. from the nuclear power stations as well as from experimental reactors.

Work done on the elements will be by remote control machinery which can be rearranged or replaced after being decontaminated without the necessity of personnel entering the caves.

To ensure that the working areas remain free from contamination the pressure in the caves is kept below atmospheric pressure so that any leak that should occur would be inwards.

The facility is scheduled to be completed and operating by the end of the year.

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An £8-million contract for the supply of two complete sugar factories for the U.S.S.R. has been signed in London by Techmashimport of Moscow and by Vickers & Bookers Ltd., the joint company formed for developing sales and supply of machinery for beet-sugar factories to the U.S.S.R., China and other Eastern European and Far Eastern countries. The order follows the contract secured earlier by Vickers & Bookers for over £500,000-worth of beet-sugar unit equipment for the Soviet Union.

The new order calls for the supply of two factories, one in the Moscow region and the other in the Ukraine. Each of the factories is to have a daily capacity of 5,000 tons of sugar beet.

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The General Electric Co. Ltd., in association with Vacuum Industrial Applications Ltd., has received an order for the supply of a vacuum melting furnace to the British Iron and Steel Research Association for use in their Sheffield laboratories.

The furnace has a melting capacity of 56 lb. and is to be used for research into the vacuum melting and casting of ferrous metals. The working pressure of the furnace is 1 micron Hg and it is designed for a working temperature of 1,700°C.; the charge is poured into the moulds by tilting the crucible.

The 24-in.-diam. furnace chamber is horizontal to provide ample working space and to permit easy cleaning of the inner surface. Within the chamber are dip thermocouples for temperature measurement, and also six tipping buckets for adding alloying metals to the molten charge.

The chamber is evacuated by means of a two-stage pumping system comprising a 10-in. oil booster-diffusion pump backed by a gas-ballasted rotary pump. The pumping speed of this combination is high enough to maintain the chamber pressure under conditions of severe outgassing.

The charge is induction heated and power for the furnace is supplied by a 10-kc/s. motor-alternator.